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JOURNAL

OF THE

FRANKLIN INSTITUTE

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OF THE STATE OF PENNSYLVANIA,

FOR THE PROMOTION OF THE MECHANIC ARTS.

DEVOTED TO

MECHANICAL AND PHYSICAL SCIENCE,

Civil Engineering, the Arts and Manufactures,

AND THE RECORDING OF

AMERICAN AND OTHER PATENT INVENTIONS.

EDITED BY

JOHN F. FRAZER,

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THE FRANKLIN INSTITUTE

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FOR THE

PROMOTION OF THE MECHANIC ARTS.

JANUARY, 1857.

CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

On the Improvement of the Ohio River. By Ellwood Morris, Civ. Eng.

The rapid settlement of the country west of the Alleghenies, and especially of the North Western United States, the vast increase of commercial wealth in the States bordering the Ohio River, the dependence of that commerce upon the waters which originated it, the working operations of the Pennsylvania Central, and Baltimore and Ohio Railroads, (whose receipts are seriously diminished by low water,) and the progress westward of the Virginia Central Railroad, all unite with other obvious considerations, to give more than usual weight at the present time, to a proposition for permanently improving the navigation of the Ohio River, and making it available at all seasons for the transit of the largest steamboats.

All these great railroads have their western termini upon the banks of the Ohio, and notwithstanding their prolongation westward by other railways, the *two* now in operation, are found to be very much dependent upon the navigation of its waters for the magnitude of their business.

These *three* great trunk lines of railroad, *two* of them now in successful operation, having ultimately, *four* terminal stations in communication with the Ohio River, and being capable of furnishing prompt and powerful means of steam transportation over the mountain ranges to the Atlantic seaboard, add greatly to the present importance of a perennial Ohio

River navigation, as through these railroads the products of the West, water-borne to their termini, may reach those points of transhipment more economically, than in any other possible way; and having reached them by means of steam power upon the water, will be drawn across the Alleghenies by steam on land, over great iron roads, on which all the resources of modern art have been lavished.

Prior to the construction of these railroads, this question had less importance, for the canals and turnpikes could never have borne away the products of the West as rapidly as they could have been brought forward to the transhipping points, by the Ohio River steamers, if moving upon an adequate depth of water. But these new and modern means of transportation—these great iron roads—will enable us to take away from the banks of the Ohio, and promptly lead across the mountains to the sea-side, whatever the steamboats may be able to bring to their termini—and this assimilation of the capacity of carriage by land and water now or recently developed for the first time—obviously and favorably changes the whole aspect of this question, and offers the strongest inducement for the immediate improvement of a navigation from which such great results may confidently be anticipated.

These and other facts of recent origin have rendered a permanent navigation of the Ohio River, of more consequence perhaps to the central United States, than any other scheme of internal improvement, which has lately been agitated, or is likely soon to invite the attention of the public mind.

To replace the uncertain and fitful navigation of the Ohio River, by a certain and permanent one, ready for use at all times and seasons, and adequate to bear upon its bosom steamboats of the first class, would doubtless prove the highest benefit that could now be conferred upon the commerce of the bordering states.

The states of Pennsylvania, Ohio, Virginia, Kentucky, Indiana, Illinois, and Missouri, with the leading cities which concentrate their commerce, are more than ever interested in an adequate improvement of this great river, since the developement of the power of steam transportation upon the iron roads, across the mountain ranges, gives certain assurance of the existence of an ability to promptly lead the bulky products of the Ohio valley, directly to the sea. The inducements however to the improvement of the Ohio River, and the material benefits that cannot fail to flow from it, are so great, so numerous, and so obvious, that it is out of the power of the writer to notice them adequately in the prefatory portion of a technical communication: nor is it indeed necessary to do so, for the reflections of the intelligent reader, will not fail to supply any deficiency in this branch of the subject.

Of the Plans for Improvement.—Lieut. Maury, in his Physical Geography of the Sea, has well said, that: "The atmosphere pumps up our rivers from the sea, and transports them through the clouds, to their sources amongst the hills." And one of our most eminent meteorologists, many years ago, proposed to the Congress of the United States, to arrest the water in these vapory conveyances *by means of fire*, and to maintain the navigation of the Ohio River *by producing rains at will, upon its sources.*

Whatever may be thought of the practicability, or of the efficacy, of the means proposed by this eminent meteorologist for the attainment of a practical end, of such magnitude—it is evident that the great idea was fully grasped by him, *of maintaining the navigation by equalizing the flow, or supplying by his intended rains, as though from reservoirs, the deficiencies of that flow, during the dry season.*

This great idea—*that the failure of the navigation of the Ohio River, is due to the failure of the supply of water alone, and that a restoration of the deficiency at will, solves at once the important problem of forming a perennial navigation*—has been more recently taken hold of by one of our ablest Civil Engineers, and elaborated into a beautiful practical system, which insures the control and supply of the requisite quantity of deficient water, by arresting it amongst the hills soon after its deposit from the clouds, and regulating its passage from artificial receptacles, so as to insure, and to maintain, a uniform navigable flow of adequate depth in the channel of the Ohio River, throughout the entire year.

As the idea of improving the navigation by supplying the deficient water, leaves the channel of the Ohio precisely as it now is—*free from obstructions of every kind*, and accessible at all times, by every town and village on both its shores—it has in this, as will be seen hereafter, a vast advantage over every other plan, all of which propose to place obstructions of some sort in the navigable channel, and then to overcome those self-created obstructions by artificial means.

The Government of the United States, with the view of improving the navigation, have already placed obstructions in the channels, which are real nuisances at several points—and they have expended large sums upon the *wing dams*, forming the attempted improvement.

The system of *wing dams* proceeds upon the simple idea *of concentrating the low water flow of the river, by contracting its channel at occasional points.*

This has been pretty fully carried out upon the Upper Ohio, and though in use for years, it is to this day a debatable question amongst the Ohio River men, whether or not, any good at all has resulted from these operations of the Government; and while it may be admitted that in some cases the wing dams have been slightly useful, it is quite clear that in others they have been absolutely injurious—whilst as a whole, the wing dam improvement must be regarded *as a most decided failure;* which fully confirms the experience of European engineers, on the utter inadequacy of this method to form a permanent improvement of a river navigation.

Of late years *three* plans (and only three), which seem at all practicable, or in any degree adequate to the object, have been proposed for the improvement of the Ohio River navigation.

1. *The Plan of Reservoirs or Artificial Lakes.*
2. *The Plan of Dams and Locks, or Slack-water Navigation.*
3. *The Plan of Low Dams and Chutes, or Pool and Current Navigation.*

Of these *three* plans, the first alone is complete within itself—as both the second and third require the aid of reservoirs to insure their successful operation in practice, and thus admit them as *auxiliaries.*

The writer proposes to consider these plans in succession, but will notice the two latter only briefly, as *the Reservoir Plan* is, beyond all comparison, the first in importance—the most certain of success—and the most likely to be satisfactory to the people of the West—since it proposes no obstructions in the river, *which both the others do.*

I. *The Reservoir Plan.*

This plan originated in the genius of Charles Ellet, Jr., Esq., an able civil engineer, whilst engaged in the construction of the celebrated suspension bridge over the Ohio River, at Wheeling, Virginia, and was very fully developed by him in a paper laid before the Smithsonian Institution, September 17th, 1849, and published by authority of that body.

Some additions have since been made by the same author (while subsequently employed by the War Department, upon the Mississippi overflows), and the whole has been embodied and re-published in a handsome octavo volume, by Lippincott, Grambo & Co., of Philadelphia, 1853.

From these papers much of what follows is derived, and the acknowledgment is now made for the materials used, but the treatment of the subject is the writer's own, and for which he alone is responsible.

This explanation is made because the writer, in support of the reservoir plan, proposes to subject it to the most unfavorable test, in order to remove all possible objections, a test which the author of the plan would hardly sanction, but one that demonstrates its entire practicability, and its adequacy to the object *at a moderate cost*, though much greater in point of expense, than the author of the plan has proposed.

Mr. Ellet availed himself of the means at his command at Wheeling, to make such measurements of the Ohio River in that vicinity as enabled him to deduce a formula, from which the flow of the River could be correctly calculated when the depth of water upon the Wheeling Bar was known, and of this data fortunately a regular diurnal record has been preserved and reported from 1838 to 1848—*eleven years.*

Six of these years—1843 to 1848 inclusive, have been mainly employed in the illustration of this subject; the daily depths of water upon Wheeling Bar during these *six years*, have been profiled by the writer from the tables given, and will be found at Plate I., which exhibits to the eye at one view, the great variations of the daily surface of the Ohio River as marked on Wheeling Bar, the shaded portions showing the daily deficiencies, *under the line of six feet deep*, which it is proposed to make good by means of reservoirs.

The first great question that arises is:—*whether the ordinary annual flow of the Ohio River at the City of Wheeling, is adequate to the maintenance of a permanent steamboat navigation six feet deep, if this flow could by any means be equalized throughout each and every year?*

This is decisively answered by Mr. Ellet, in the following statement of the aggregate flow for six years, in which the discharge of the River is computed day by day from the empirical formula based upon adequate measurements.

"The total discharge of the Ohio (at Wheeling) was in

1843 = 961,382 *millions of cubic feet.*
1844 = 650,982 "
1845 = 555,482 "
1846 = 879,119 "
1847 = 1,142,258 "
1848 = 822,719 "

Total for six years, = 5,011,942 "

Annual average, = 835,323 "

Daily average, = 2,287 "

or by the formula, adequate to have maintained throughout this term of six years, *an uniform depth of nearly nine feet!*

From this statement it appears, that *double* the quantity of water descended the river in the maximum year 1847, when compared with the flow of the minimum year 1845, and it also appears that *the average* daily flow supplies nearly *twice* the quantity of water, which is necessary to maintain a constant depth of *six feet* water in the steamboat channel.

The surface drained above Wheeling is estimated "at 24,337 square miles, or 678,476 *millions* of square feet," and in each of the above years the drainage (or available downfall water) was computed to be as follows:

Inches vertical.	Inches vertical.
1843 = 17	1846 = 15 $\frac{55}{100}$
1844 = 11 $\frac{52}{100}$	1847 = 20 $\frac{20}{100}$
1845 = 9 $\frac{83}{100}$	1848 = 14 $\frac{57}{100}$

Total drainage for six years, = 88 $\frac{67}{100}$

Annual average, = 14 $\frac{778}{1000}$

Assuming "the average annual fall of rain at the head of the Ohio," to be about 36 inches, this available downfall is equivalent to about 40 per cent. of the usual rainfall of an average year; which is somewhat less than the results obtained by other engineers in this country, who have been called upon to plan or build reservoirs for canals or water-works, and to compute the vertical drainage of their basins, which can be concentrated in them annually, from an area of country carefully surveyed.

To illustrate this subject further, we avail ourselves of data furnished from the personal experience of William J. McAlpine, Esq., Civ. Eng., in his able Report upon the Brooklyn Water-works.

Year experimented on.	Name of stream gauged.	Elevation above tidewater in feet.	Character of the water shed.	Whole rainfall in ins. per annum.	Vertical downfall drained away by the streams.	Ratio of available drainage to the whole rainfall, per cent.	Locality.
1835 and 1836	Eaton Brook,	1350	Steep and impervious.	34	23	66	Madison Co. NY
	Madison Brook,	1200	Less steep and more pervious	35	$17\frac{1}{2}$	50	the same.
1850 and 1851	Patroons Creek. near R.R junct'n	300?	Flat country.	46	25	55	near Albany NY
	Patroons Creek. near Tivoli Falls	300?	Flat country.	42	$17\frac{1}{2}$	42	the same.
Totals,		3450	Mixed.	157	83	213	State of
Averages.		862	Mixed.	39	21	56	New York.

English experiments quoted by Mr. McAlpine, give generally much higher ratios of drainage to rainfall, (though with some exceptional cases;) thus, in ten localities in England, the ratios were 43, 49, 53, 54, 60, 61, 66, 67, 82, and 83 per cent., *averaging about sixty-two per cent.;* the results of this humid climate, however, are not considered as entirely applicable here.

"Some experiments made by order of the Water Commissioners of the City of Boston, in 1837 and 1838, show that in the drainage of Long Pond, about 11,000 acres, *forty-four per cent.* of the falling water, passed off through the streams."

The Silver Creek Reservoir of the Schuylkill Navigation, near the summit of the Broad Mountain, in Schuylkill County, Pennsylvania, at an elevation of 1512 feet above tide-water, and 115 miles distant therefrom, was located by the writer in 1847, and calculated to use the entire drainage upon an assumed available downfall of $13\frac{1}{5}$th inches, or about 37 per cent. of the average rain-fall of three feet.

The construction of this reservoir (of which the whole surface drained had been accurately surveyed), proved conclusively to the mind of the writer, after observing its working for several years as Superintendent of the navigation—that the ratio of drainage assumed in its location *was too low;* and that *fifty per cent.* at least of the rain-fall could have been utilized on *that* reservoir site. The drainage of the basin of Anthony's Creek, a tributary of the Great Kanawha, has been shown by the measurements of E. Lorraine, Esq., C. E., to have been $65\frac{1}{2}$ per cent. of the rain-fall, on an average of five years; that average rain-fall having been $36\frac{1}{3}$ inches per annum.

The writer, therefore, thinks it safe to assume, that in the construction of reservoirs near or upon elevated grounds, with moderately steep watersheds of ordinarily impervious material, *fifty per cent. of the rain-fall, or eighteen inches vertical, may be utilized in reservoirs.*

The question being settled beyond any doubt that the ordinary flow of the Ohio River, if uniformed throughout the year, is more than adequate for the object, the second great question is,—*can this flow be equalized wholly or partially, and in what manner?*

Before entering upon the solution of this question, it is proper to state that the largest steamers in use upon the Upper Ohio, require but *six feet* plumb depth of navigable water for their floatation *loaded;* and that with *six feet* depth of water in the channel, the river is known to have been closed *by ice* but very rarely in its history, and with that depth flowing uniformly away, before and during cold weather, *a closure by ice would probably never occur.*

If, then, we can partially equalize the flow, so as to maintain regularly a navigable depth *of at least six feet water* in the Ohio River, we shall overcome at once, both the great obstacles which now so seriously impair the usefulness of that noble river, as to have partly justified the celebrated sneer, that "it was *dry* half the year, and *frozen* the other half!"

Can we partially equalize the flow so as to insure and to maintain six feet plumb depth of navigable water, and by what means?

The answer is, *by Reservoirs.* The same means which have been successfully used for two centuries, upon canals *when short of water.*

For the Ohio River technically considered, is merely a grand canal, 1000 miles long, and 1000 feet wide, with an average descent of half a foot to the mile, and it admits of being supplied with water by the same means as other canals, only proportioning those means properly to the magnitude of the case.

So long as a navigable depth of *six feet water* is produced by the natural flow, the navigation of the Ohio is all that can be desired, *but when the water fails, of course the navigation fails.*

Keep up the supply of water then, and the navigation becomes *perennial.*

The parts of canals which have hitherto been supplied with water from reservoirs in this country and elsewhere, are usually either summits, or the higher levels where the ordinary flow of the country is inadequate, and, hence, these reservoirs required to be located in an elevated country, and were, consequently of comparatively small dimensions, though at the same time they probably availed of a deeper rain-fall than has been realized on lower ground.

Upon various canals in this country, over *twenty* of these reservoirs are now in successful use.

Now, the Ohio River forms the lowest line in its valley, and lays so far below the level of the upper waters of its leading tributaries, as to render it easy to find sites for reservoirs of vast magnitude—*not mere ponds, but artificial lakes in fact*—and nothing less will answer, in the view the writer proposes to take of this question.

Mr. Ellet, contemplating the establishment of comparatively small *receiving reservoirs*, to be filled and emptied frequently during each year, and controlled in their discharge by *regulating reservoirs* upon the larger affluents, has declared that, "It is not his intention to recommend the construction of dams upon the great navigable tributaries of the Ohio, until the appropriate sites upon the smaller affluents have been first exhausted."

And he has most ably argued his case, *upon the hypothesis of small* *receiving reservoirs frequently filled and emptied every year, and controlled in their discharge by regulating reservoirs.*

This view necessarily results in a very moderate outlay for *reservoirs*—a cost so small indeed, as stated by the author of the plan, as to have raised the strongest doubts in the minds of many; and though in this form, the case has been stated with rare ability, and proved by the author of the plan, to the very verge of demonstration, nevertheless this reasoning does not appear to have carried to all minds the conviction due to the merits of the argument, and it cannot be denied that many have doubted its adequacy, while some have even gone so far as to consider it chimerical.

Whilst, therefore, Mr. Ellet has taken, probably, the most favorable view of the results to be expected from the admirable plan devised by him—it may be well to examine it *in its most unfavorable aspect*, for the satisfaction of those who receive these new ideas with difficulty.

It is this task which the writer proposes to himself,—to examine the feasibility, and the probable results of the Reservoir Plan, *upon the ordinary hypothesis applied by Engineers to the construction of reservoirs to feed canals*, where the whole deficency of water is first ascertained, and then the reservoir capacity is calculated, to collect and control that deficiency, *upon the supposition of the reservoirs being filled and emptied but once a year.*

This will be judging the Reservoir Plan by a much more severe test, than its able author has thought proper to subject it to—by one indeed harder than may be necessary, but which must be considered as the most unfavorable view that can be taken of this great question, and as a test adequate to settle all doubts upon the subject.

We will therefore assume, *that the reservoirs are filled and emptied but once a year*, and will take for our guide the year 1845 (see Plate I.) as being the most difficult to manage of all those which Mr. Ellet has tabulated; a year in which for 218 days, the waters of the Ohio River were less than six feet deep on Wheeling Bar, and of which the entire flow, if fully equalized, would only have furnished an uniform depth of *seven feet* throughout the year.

Using Mr. Ellet's methods of computation we find approximately that the deficiencies of that year (1845), below our proposed navigable gauge of 6 feet deep on Wheeling Bar, were as follows—disregarding those days when the water was 6 feet deep or more.

Deficiencies of 1845, *under* 6 *feet deep, on Wheeling Bar.*

					Cubic Feet.	
January	=	2	days of deficiency under 6 feet deep	=	450	Millions.
February	=	8	" " "	=	1,725	"
March	=	0	" " "	=	0	"
April	=	21	" " "	=	9,705	"
May	=	20	" " "	=	11,930	"
June	=	25	" " "	=	17,452	"
July	=	24	" " "	=	14,746	"
August	=	31	" " "	=	24,744	"
September	=	30	" " "	=	20,388	"
October	=	15	" " "	=	6,341	"
November	=	17	" " "	=	6,714	"
December	=	25	" " "	=	12,015	"
Totals		218			126,210	Millions.

In this year then, disregarding the times when the water was *over six feet deep*, we have more or less deficiency, occurring on 218 days (some in every month but one), and amounting in the aggregate to a deficient flow, *requiring a supply of the very large quantity of* 126,210,000,000 *cubic feet of water per annum.*

With this striking example before us, we will now assume in round numbers that the deficiency necessary to be supplied to make good *six feet* plumb depth of navigable water the year round, may in some unfavorable years, amount to the very large quantity *of* 150,000 *millions of cubic feet of water per annum;* and that this quantity will have to be annually accumulated and held in reservoirs, if, as we are now supposing, *these reservoirs can be filled and emptied only once a year.*

This will be admitted to be a most severe hypothesis by which to test the Reservoir Plan, but it will appear plainly too, we hope, before the close of this discussion, that the plan is adequate even to such a test.

Proposing to go back upon the great tributaries of the Ohio, the Allegheny, and the Monongahela, we should seek our reservoir sites in or near the elevated country, where we should find an available rainfall *deeper* than the average drainage from the whole valley taken together, *and where eighteen inches deep over the whole surface drained may safely be assumed as the proportion of downfall water which may, one year with another, be utilized in reservoirs.*

We have then $\frac{150,000,000,000}{1{\cdot}5} = 100,000$ millions of square feet of surface drainage required to fill our reservoirs *once a year.*

And $\frac{100,000,000,000}{27,878,400} = 3587$ square miles of drainage needed, or in round numbers, *say* 3600 *square miles.* This is equal to a square area of 60 miles on a side, or to *six* oblong areas of 40 miles long by 15 miles wide.

Can we find six reservoir sites upon as many creeks, each draining a basin equivalent to 40 miles long by 15 miles wide?

Can proper locations be found at the lower ends of these basins for the *six* dams necessary to form *six* lakes, commanding each a drainage of 600 square miles? Or for a greater number of lakes of equal aggregate capacity?

These questions the writer believes, can be answered in the *affirmative*, by a well conducted survey, and they form the only questions of importance, which remain unsettled in the discussion of this great subject.

For the present we will assume, (what we do not doubt,) that *six* suitable sites can be found, and that six dams can be erected on them, *each* ponding back, or giving an annual available capacity of 25,000 millions of cubic feet of water, or 150,000 millions per annum in all. And now let us see what sort of dams these lakes would require? what the proximate extent of the pool? and what the nature of the feeding apparatus?

We will here observe, that the reasoning which leads the writer to conclude that suitable reservoir sites can be found, is based upon a knowledge of these facts.

1. That the channels of the leading tributaries of the Allegheny and

Monongahela, or certain portions of them, descend at the rate of about four feet to the mile.

2. That reservoir dams are always located in the contractions of valleys. Consequently, locations would be sought, (and doubtless found,) upon streams descending about four feet per mile; while the dams would be placed in gorges where such streams break through ranges of hills.

Established at proper points upon such streams, dams of 100 feet *water raise*, would swell back about 25 miles upon the main streams, and swell out above the gorges to a width of a mile or more, and up all the small affluents, to an extent that will give us probably an average breadth of surface of near $\frac{3}{4}$ths of a mile, with an available depth of 50 feet; these dimensions would give us 25,000 millions of cubic feet of water, the quantity required for our purpose in each of *six* reservoirs, and such sites in the opinion of the writer, may be readily found by suitable surveys.

The writer is the more confident in the expression of this opinion in consequence of having been called on in the course of his professional experience, to locate *eight* reservoirs, and to construct *two*. Those who have had occasion practically to locate the dams, and to see the water lines of reservoirs patiently traced out upon the ground, with the spirit level, will not hesitate (we believe) to admit the strong probability of adequate sites being found of the dimensions stated, *but this question can be determined absolutely only by survey.*

Admitting that sites can be found, whereon with proper works, we might store up for use *in each of six reservoirs*, the large quantity of 25,000 millions of cubic feet of water, the next question is, *are such works practicable?*

The answer to this by every civil engineer must be in the affirmative, for reservoirs form some of the oldest constructions, known to the profession as well as some of the most recent.

From the Saint Ferrèol Reservoir, constructed in 1667, on the Languedoc Canal, in the heart of France, (and still in successful use,) down to the *twenty* reservoirs constructed of late years by the civil engineers of this country to feed various canals, the formation of such works has been well understood, and they have invariably been successful.

To show the method usually adopted in this country, for the construction of such works; the writer refers to the transverse sections of three reservoir dams (see Plate II., Figs. 1, 2, 3,) of which a brief description only, will be necessary.

They are formed by a heavy mound of water-tight earth thrown across a valley at a suitable point; this bank of earth is connected with solid and impervious bottom, by a deep longitudinal excavation called the puddle-ditch, subsequently filled with the best material attainable, and wetted if practicable. At the ends, this puddle-ditch filling is connected with, and stepped up upon impervious ground, cut into deep benches. The mound is always protected and weighted upon the exterior or land-side by means of a mass of stone called the riprap, and is often secured on the water-side with a slope wall of stone.

In all cases, these mounds of earth require to be combined with a wide waste wier excavated into the hill, on one or both sides, and fully adequate *to waste the entire stream in flood when the reservoir is full.*

Referring now to Plate II.

Fig 1. Is a transverse section of the Reservoir Dam, constructed by the Schuylkill Navigation Company, in 1848 (under the direction of the writer), on the head of Silver Creek, in Schuylkill County, Pennsylvania.

Fig. 2. Is a cross section of the Reservoir Dam (called the Berger Reservoir,) constructed by the Union Canal Company, in 1849, on a branch of the Swatara, near Pinegrove, Schuylkill County, Pennsylvania, under the direction of Wm. Lehman, and B. B. Lehman, Esqs., Resident Engineers, (who have kindly furnished the Section).

Fig. 3. Is a transverse section of a Reservoir Dam, now, 1856, in the course of construction (under the direction of the writer), by the Pottsville Water Company, at Pottsville, Penna.

DETAILS.

a. Valve house containing the stop-cocks. (Double.)
b. Riprap formed of coarse stone.
c. Puddle-ditch, sunk to impervious material.
d. Head of pipe wall, of cement masonry.
e. Feed pipes (12 inches), laid on cemented masonry.
f. Water of the Pool formed by Dam.
g. Embankment of earth, carted in thin layers.

The chief novelty in these reservoirs, is the mode of feeding *from the lower ends of the pipes*, first adopted by the writer at Silver Creek, in 1847, and since successfully applied to two other reservoirs. At the lower end of *each* pipe are two stop-cocks, both so arranged as to be accessible at all times for repairs and supervision, and one of which acts as a guard for the other.

These transverse sections, with the references above, fully explain themselves, and are introduced here to show *that these constructions are common and well understood works of engineering.*

In 1837 or '38, *two reservoirs* were constructed for the State of New York (by John B. Jervis, Esq., Chief Eng., and William J. McAlpine, Esq., Assistant Eng.), for the purpose of feeding the Chenango Canal; one of these had *a water raise* of 45 feet, and the other of 50 feet, and both had similar sections to those marked upon Plate II.

In 1839 and subsequent years, the State of Pennsylvania, to supply her mainline of canal, constructed two reservoirs at the foot of the Allegheny Mountains, one on either side—the Eastern Reservoir has *a water raise* of 28 feet—the Western Reservoir of 62 feet; they both have transverse sections generally, similar to those of Plate II, having slopes *inside* of 2 to 1, and *outside* of 1½ to 1, with heavy ripraps externally. These were planned and chiefly constructed by William E. Morris, Esq., Civil Engineer.

It seems unnecessary to multiply examples where the constructions are all so similar ; *over twenty reservoirs* are now in successful use upon the canals in this country, performing towards them in dry seasons, precisely the same offices as the reservoirs proposed by Mr. Ellet will perform, towards the Ohio River.

The Saint Ferrèol Reservoir, built in 1667, the oldest large reservoir in existence, has the following leading dimensions: (Andreossi's Histoire du Canal du Midi.)

Water Raise = 103. feet.
Height of Dam = 107. "
Length " = 2558. "
Thickness at base = 394. "

This Reservoir Dam was constructed of earth, with a walled breast of stone-work, curiously arranged. (See De Lalande's Canaux de Navigation-Canal de Languedoc.)

It is this great structure, the durability of which has been so amply tested by the hand of time, that will be taken by the writer, as the prototype of those suggested in this paper.

Our proposed Reservoir Dams, therefore, will have the general dimensions, and the same water raise as that of Saint Ferrèol, built in 1667, *in successful use for nearly two centuries, and the practicability of imitating which cannot be doubted.*

We come now to consider the feeding works necessary to stop and to let loose, *at will*, the vast body of water, which we propose to pen up in these *six* artificial lakes and see what difficulties they may involve.

The Ohio River flow in the driest season is never less than *one foot deep* upon the Wheeling Bar, but the navigable depth we need is *six feet;* the maximum quantity of water, therefore, that can ever be required in any 24 hours is the difference of the river flow at these depths for that time, or the quantity required daily, to produce and to maintain, a raise of 5 feet upon the lowest water depth of one foot—now by Mr. Ellet's tables:

	Cubic feet per day of 24 hours.
6 feet deep on Wheeling Bar, flows, .	= 1,164,000.000.
1 do. do. .	= 102,000,000.
Difference or maximum daily quantity required from reservoirs in dry weather,	= 1,062,000,000.

Divided by *six*, therefore, the feeding apparatus of each reservoir must have a maximum power under all circumstances, of expending 177,000,000 of cubic feet of water in 24 hours, *or of* 2049 *cubic feet per second.*

To expend this quantity per second would require

Under 100 feet head = 7 pipes of 3 feet diameter each.
" 16 " = 24 " "
" 4 " = 36 " "

Now, inasmuch as all the reservoirs would rarely retain at any moment of their working operation precisely the same depth of water, it seems evident that 24 *cast iron* feeding pipes, of 3 feet diameter each, would form an ample feeding apparatus, even for these artificial lakes.

Three feet in diameter is not an uncommon size for water pipes—it is the same employed in the mains of the City of New York—and of that diameter, stop-cocks are made working with a screw, which, under 100 ft. head, could be readily operated by *two men* with suitable wrenches, or even by *one man* if necessary.

We will now refer to Plate II., fig. 4, which shows a transverse section of a dam suitable for the formation of our proposed artificial lakes. The mound is proposed to be founded upon rock, and sustained and protected in front by a great mass of cemented masonry, by means of notches, in which, of the proper length, and twelve feet deep, adequate waste wiers will be formed on both sides, one on each.

That a structure of this kind is entirely practicable, and that it would make a substantial and durable work, will, we think, be admitted by every professional reader; and it now only remains to indicate roughly the probable cost.

The Estimated Cost of One Dam.

Cemented Masonry (Rubble Work), 203,000 Pers. at $4,	=	$812,000
Embankment, 1,150,000 cubic yards at 30c.,	=	345.000
24 Feeding Pipes (36 inch), 7200 ft. lineal at $15,	=	108.000
48 (36 inch.) Stop-cocks at $350 each,	=	16,800
Preparing Foundation, Puddling, &c.,	=	100,000
Clearing site, forming roads, &c.,	=	150,000
Valve house, and houses for attendants,	=	50,000
For eventually riprapping the interior slope,	=	100,000
12,000 acres of land at $10,	=	120,000
Engineering and contingencies,	=	198.000
Total for each Lake, say,		$ 2,000,000

Or, for the whole six artificial lakes, say twelve millions of dollars.

We come now to speak of the probable cost of maintaining and operating reservoirs.

It is the uniform experience of all Engineers who have had the charge of properly constructed works of this nature, *that they cost little or nothing for repairs.*

The reason is obvious; these works properly constructed consist of nothing but earth, stone, and iron, in masses suitably protected, and hence have not within them or about them, any elements of decay.

Within the first few years, settlements of the bank have to be made good, and the interior slope eventually, when well settled, should be protected with a riprap or slope wall of stone, for all which, the estimate we have offered makes due provision; once come to stability or the construction ended, there is nothing remaining to be done while earth, stone, and iron endure, and this is the actual experience with existing reservoirs

With regard to the attendance in operation, it may be observed, that works of this value and magnitude, require to be carefully watched and warded day and night to prevent depredations and interference; these watchmen, when directed, will open and close the valves; and for these purposes a force of *four men* at each reservoir would be ample; less force indeed might do, as canal reservoirs have only the attendance of a single man each; but we will assume that *four* are necessary; the *six* dams will therefore require, say 24 men, and including materials, tools, oil, paint, &c., the cost of actual maintenance at all these reservoirs cannot exceed a total of $15,000 per annum.

As collateral to this subject, we will now add a few words upon the probable effect of such large reservoirs upon the Ohio River floods.

Although it is an incident (and a very important one,) that the Reservoir Plan must necessarily act to a considerable extent to moderate the floods of the Ohio River, it does not come within the scope of the present paper to discuss that question.

It is proposed herein to form lakes of great capacity for the continued support and maintenance of six feet navigation alone; nevertheless, as those lakes are calculated to cover and to cut off the drainage of 3587 square miles out of 24,337 square miles, or over one-seventh of the whole drainage above Wheeling, and as their capacity, too, is computed to intercept the high ratio of 18 inches vertical of the whole annual rain-fall, there cannot be a doubt that they will operate materially for the reduction of floods.

For every year of which we have any history, shows some deficiency, and usually a very large one, under the line of six feet water, which is well illustrated by the shaded portions of Plate I, and as these shaded portions are to be filled by reservoirs intercepting the flood waters, they must cut off an equal quantity from those high peaks of the profiles which represent the floods.

We think it certain, then, that by a method of management which experience would soon indicate, reservoirs of the magnitude contemplated here, cannot fail to effect a great amelioration of the freshets of the Ohio River.

We will now present a brief summary of the results arrived at in the discussion of *the Reservoir Plan.*

DEMONSTRATED CHIEFLY BY THE AUTHOR OF THE PLAN.

1. That the average rain-fall in the basin of the Upper Ohio if intercepted by reservoirs in wet seasons for use in dry ones, is more than sufficient for the maintenance of six feet depth of navigable water throughout every year.
2. That the water draining away by the channel of the Ohio River as measured day by day at Wheeling, Virginia, if regulated by reservoirs, is more than adequate to the maintenance of a navigable depth of six feet throughout each year.
3. That by means of reservoirs, the equalization and regulation of the flow of the Ohio River, to the extent necessary to maintain a permanent steamboat navigation six feet deep, can be certainly and economically effected.
4. That reservoirs are common and well understood works of engineering, which when judiciously located and constructed, never fail in their object, and that over twenty of them are now in successful use upon various canals in this country alone.
5. That six feet depth of navigable water is ample to maintain a permanent steamboat navigation, and also to keep the river clear of stoppage by ice.
6. That by employing receiving and regulating reservoirs of small size, frequently filled and emptied annually, a navigable depth of five feet* could be maintained, by means of an outlay in reservoirs of only one million of dollars.
7. That by using six large artificial lakes, to be filled and emptied but once a year, a navigable depth of six feet can be permanently maintained by an outlay in reservoirs of twelve millions of dollars.
8. That the reservoirs constructed of imperishable materials will require no repairs, when once properly finished.
9. That the expense of operating the reservoirs in the maintenance of six vertical feet of water, by means of six artificial lakes, will not exceed $15,000 dollars per annum.
10. That six artificial lakes of the size herein contemplated, could not fail to exert a material influence in moderating the Ohio River floods.

We will conclude this branch of our subject by observing; it appears evident, that taking the most *favorable view* of the Reservoir Plan, an outlay of only one million of dollars in reservoirs may maintain a *five feet*

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* Mr. Ellet has framed the reservoir plan, and argues it at present, with a view to *five feet* depth of water only, and by the use of reservoirs often filled and emptied every year, proposes to effect this, for the astonishingly small outlay named.

Fig. 1.

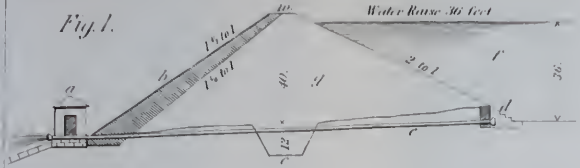


Fig. 2.

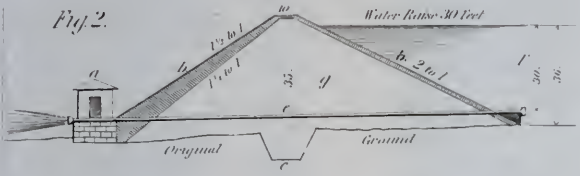
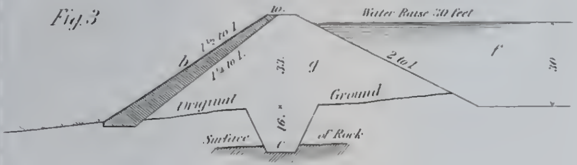
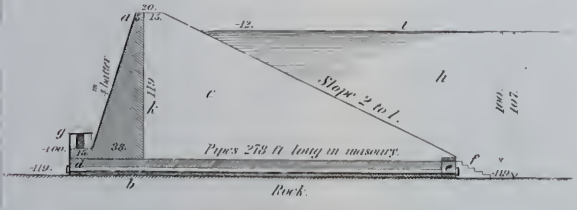


Fig. 3



Scale 50 ft. to the inch

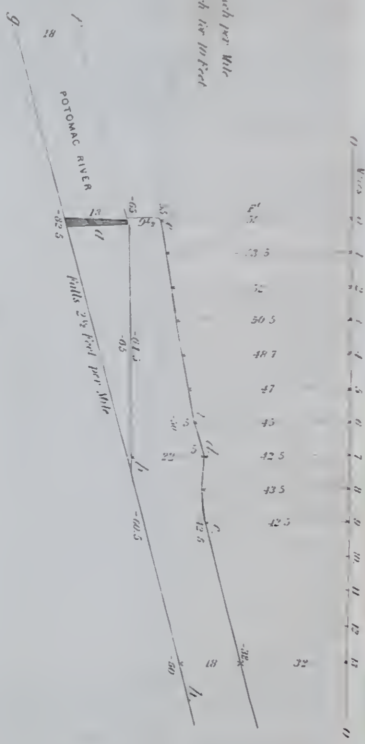
Fig. 4.



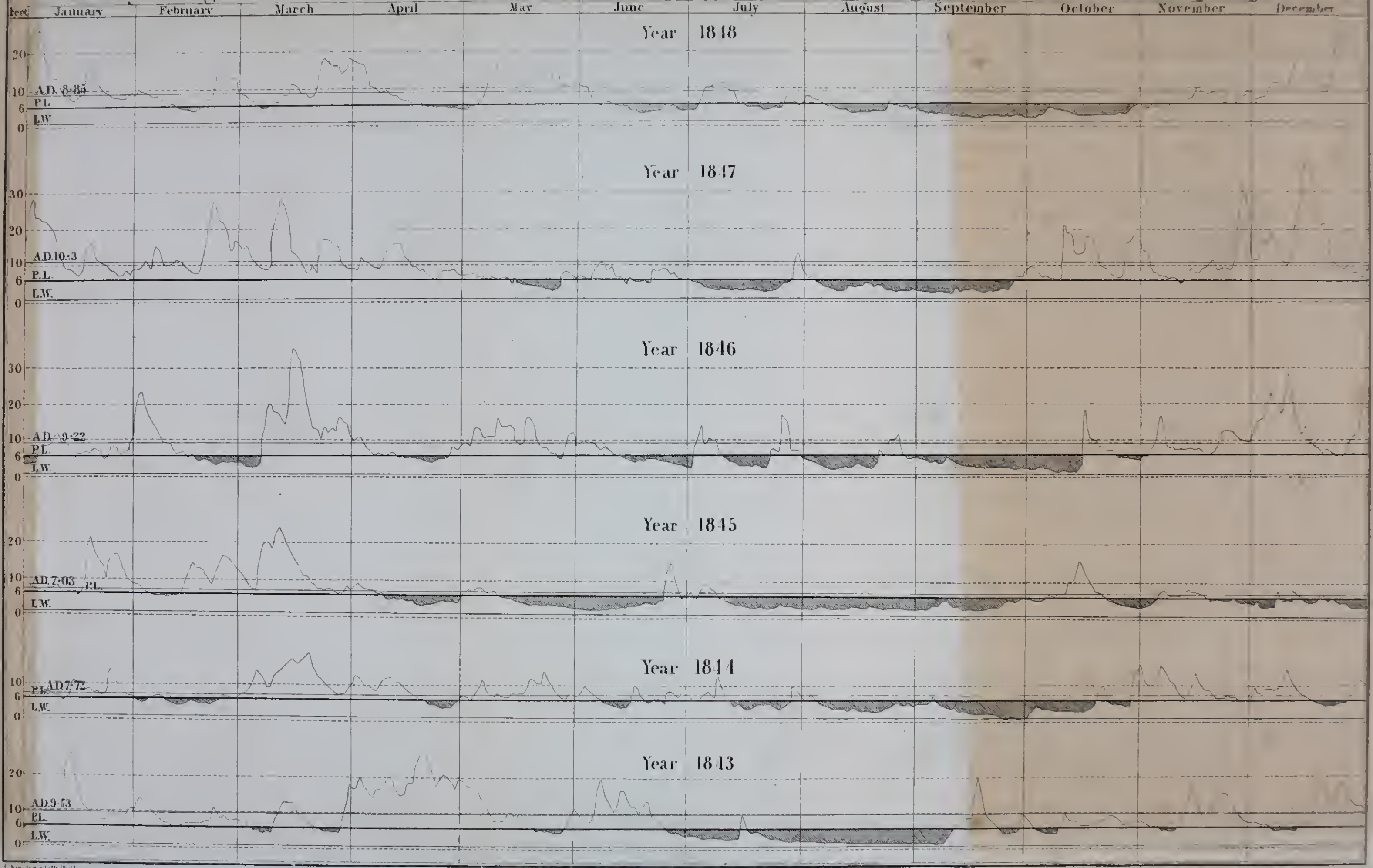
Scale 100 ft. to the inch

Fig. 5.

Horizontal Scale 1 inch per Mile
Vertical Scale ¼ inch to 10 Feet



Daily Heights of Water in the OHIO RIVER for Six Successive Years taken upon the Bar at Wheeling Virginia.



T. Sinclair's Lith Phil^{a}

navigation, while by taking the most *unfavorable view*, a permanent navigation *six feet deep* in the Ohio River can be certainly established by an outlay of twelve million of dollars.

We will now proceed to discuss the other plans proposed for the improvement of the Ohio River navigation.

REFERENCES TO PLATES.

PLATE I. Daily heights of water in the Ohio River, for six successive years, taken upon the Bar at Wheeling, Virginia, and Profiled from the Tables of Charles Ellet, Jr., Civ. Eng.

The shaded parts show the deficiencies required to be supplied in each year *from reservoirs* to make good a navigable depth of six feet throughout each year.

o. Level of top of Bar at Wheeling, or zero of the Wheeling water gauge.
LW. Lowest water at Wheeling, or one foot deep upon the Bar.
PL. Proposed level to be maintained by Reservoirs, equal to an uniform navigable depth of six feet.
AD. Average depth of each year, supposing the flow to be equalized throughout.

PLATE II. *Fig.* 4.—Proposed section of Dam for artificial lake.
a. Rubble wall laid in cement.
b. Foundation of wall and bank on rock.
c. Bank of earth, carted in thin layers.
d. Outlet of the three feet feeding pipes.
e. Inlet of the three feet feeding pipes.
f. Head-wall of feed pipes, laid in cement.
g. Valve-house, for the feeding arrangement.
h. Water ponded back, or body of the lake.
i. Water surface of the lake.
k. Rear of wall, to be plumb, and plastered with cement.

PLATE II. *Fig.* 5.—Freshet Profile of Dam, No. 5, of the Chesapeake and Ohio Canal, on June 1st, 1836.
a. The Dam, a wooden crib-work, the comb, = 17½ feet above common low water.
b. Surface of Pool at common low water, about 6 inches above the comb.
c. d. e. " " the highest of the Freshet, by levels taken on the spot.
f. c. Top level of the Freshet, beyond the influence of the Dam, showing also top water, supposing Dam removed.
g. h. Surface of ordinary low water in the Potomac River, ascertained by accurate levels.
o. o. Reference level, or Datum line.
b. Point where level of comb strikes the level of common low water. Dotted line is level of comb of Dam. At points *d. e.* rise of Freshet over the line *f. c.* = 5 feet.

(To be Continued.)

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*Description of the Drainage of the Haarlem Mere.**

(Continued from Vol. XXXII—page 370.)

The principal condition of the contract with the district was, that in summer the level of the *boezem* should not be raised more than 17 centim. (6·⅞in.) above M. L., while in the winter 15 centim. more, or 32 centim. (12½ in.), were allowed. These conditions have, to a great extent, increased the duration of the work, and accordingly the expense of the drainage, while they necessitated the constant stopping of the engines, when the prescribed level was attained. In the meanwhile, the enclosure of the lake was finished, and two other engines were constructed of the same power and arrangement as the *Leeghwater*, with some few modifications, which have been indicated above. One of the two is placed on the spot where the river *Spaarne* unites with the intercepting canal, the greatest quantity of water raised by it being conducted to *Spaarndam*, where it is discharged into the Y. It is called the *Cruquius*, after the name of a man who, in the year 1742, made a skilful plan for draining the mere, while the other is placed on the north side, in the vicinity of the sluices at *Halfweg*. It is called the *Lynden*, in honor of Van Lynden van Hemmen, Bart., who in 1822 published an excellent treatise on the drainage of the mere, but did not live to see the realization of his cherished idea. Both these engines are indicated on the map by their respective names. The building of the *Cruquius* was contracted for, for a sum of 220,665 fl., but to this sum are to be added 10,000 fl. for the unusual difficulties encountered in laying the foundations, which were of such a nature that the contractor had nearly given up the work, so that the total cost has been 230,665 fl. (£19,222). The soil, at the depth required for the foundation, was of such a nature that the utmost energy and nicety of skill were required to overcome the almost insurmountable difficulties. It consisted of a layer of shale, through which water and sand percolated with such force that a portable steam engine of 10 H. P., and three other machines for raising water, moved by sixty horses,* were not capable to discharge the water and sand at the same rate as it entered at the bottom. At the same time, the sides of the pit were forced out by the superincumbent weight, so that another mode of working had to be adopted, or the work given up. Therefore, to prevent the sides of the pit from slipping, heavy deals were driven in the bottom, close against them, one near the other, forming, as it were, an immense tub, so that the water could not enter then through the bottom, whence it was duly discharged by the addition of a fourth machine, so that a power of no less than eighty-four horses, besides the steam engine, were night and day at work to raise the water, which entered continuously with great force. Durihg this time, no less than 1700 piles had to be driven in the bottom of the pit, and a woodon platform laid on their tops; this work had to be carried on with the greatest possible dispatch, no less than 450 men being at work in the pit at the same time. In this manner art has triumphed over the obstacles, so that the building has been elevated on a firm and secure foundation. The other building presented no difficulties whatever, and was erected for a sum of 218,528 fl. (£18 210).

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* From the Lond. Artizan, August, 1856.

The two engines, with the levers and boilers, were contracted for by the same firms which had constructed the *Leeghwater*, for a price of 639,423 fl. (£53,285). They were to be finished in August, 1848, but from various circumstances it was not before the beginning of 1849 that they could be set at work.

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* The machines generally made use of in Holland for draining deep foundations are a sort of noria, consisting of a square wooden trunk lying at an angle, it being open at both ends; the bottom end enters the water and the top is laid at the level to which the water has to be raised. An endless chain. passing over rollers, at the top and bottom of the trunk, passes through it, being provided at short distances with square boards, fitting nearly in the trunk. The upper roller being moved by horse-gear, the water contained between each pair of boards is conveyed to the required height and discharged at the top.

In the meanwhile the drainage of the mere was commenced by the *Leeghwater* alone, which had been set in action, discharging the water from the lake, on the 7th of June of the preceding year, the level of the mere being at that time 0·13 met. (5 ins.) below M. L. The *Cruquius* commenced pumping on the 1st of April, 1849, the *Lynden* eighteen days afterwards. The first engine had lowered the level of the mere during the time of its working 0·14 met. ($5\frac{1}{2}$ ins.) At this time the drainage may be reckoned to have commenced, it being finished in July, 1852, occupying thirty-nine months, a greater time than was calculated, but which is explained by the following statement :—

The three engines made, during this space of time, together, 14,004,032 strokes,[*] discharging (deducting $\frac{1}{10}$th for leakage), 831,839,501 cubic met. (817,712,236 tons) of water. At the commencement of the drainage the depth of water in the lake was 3·21 met. (10 ft. 5 ins.), which, with an area of 18,100 hectares, gives a cubical content of 581,010,000 cubic met. The rain which fell during this period has, according to very careful observations, been in excess of the evaporation by the trifling quantity of 0·0202 met. (0·7753 ins.), giving for the surface of the lake 3,656,200 cubic met., so that the total quantity of water in the mere, added to the falling rain water, amounted to 584,666,200 cubic met., falling short by 247,173,301 cubic met. (244,253,745 tons) of the calculated quantity pumped out. This difference may be partly ascribed to leakage, which undoubtedly on many occasions has been greater than $\frac{1}{10}$th of the quantity raised, and partly to the strokes not always being full ; but these causes cannot answer for the great difference which must for the most part be ascribed to filtration through the bottom and sides. This filtration, which is met with in all similar drainage works, but in this instance in a rather greater proportion than usual, goes on decreasing afterwards, when the newly-laid embankments are thoroughly dried and settled, but never disappears totally. It depends on the greater or less porosity of the soil, which, especially on the north-west side in the vicinity of the river *Spaarne*, is of a very light and porous nature. Heavy repairs were required, which, on an average, caused a delay for each engine of three months, the inadvertency of an engine driver causing the breaking down three of the heavy levers at the *Leeghwater*, while, by some unknown cause at the *Cruquius*, the ears of the great cap for the guide-rods were broken off. The buckets and foot-valves required many repairs, caused principally by the great quantity of mud collecting on the platform on which they stand, so that it had to be cleared many times, for which purpose the building had to be isolated from the mere by dams. But the greatest delay was caused by the regulations of *Rhynland* requiring the engines to stop, when the level of the *boezem* was raised to a certain height.

By these combined causes, the engines were in full work but half of the time during the drainage—viz : nineteen months and a half. The water pumped out exceeded the quantity expected (which was, as before stated, 766,000,000 of cubic met.), by nearly 66,000,000 cubic met., requiring one month and a half to be pumped out, increasing the calculated time to fifteen months and a half, leaving out a difference of four months, which is to be ascribed to the speed at which the engines were worked being less than was calculated, this being considered necessary for safety. Even assuming the very improbable circumstance, that the filtration will not decrease, the calculations show that under the most unfavorable circumstances, the engines are capable of removing the greatest possible quantity of water that may collect in a month, which has been proved by the experience acquired during the three years the lake has been dry.

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[*] This number of strokes is reduced to the total number of pumps.

In the preliminary plan it had been fixed that a fourth sluice-gate should be added, to the three existing at *Halfweg*, for giving the water a better discharge at that point. The Commissioners, however, had delayed the execution of this work, so as to watch and be able to judge correctly of the action of the steam engine at *Spaarndam* on the *boezem*, as also the influence of the enclosure of the mere, on the affluence of the water to these sluices, the water being now conducted only from the two sides of the canal. This experience showed that the existing sluices were more than sufficient to discharge the water in the direction indicated, but they saw the desirableness of erecting another steam engine. Accordingly the placing of a steam engine, after the manner of that at *Spaarndam*, was resolved upon, but pecuniary difficulties delayed the execution of this plan until the year 1850. For this engine one of the existing sluice gates has been utilized in such a manner, that when natural discharge takes place this sluice works as before, while, when needed, the water is discharged through it by the steam engine. This engine has a nominal power of 100 horses, being condensing and expansive, the steam pressure being three atmospheres. The cylinder is horizontal, diameter, 1016 met. (40 ins.); stroke, 2·44 met. (8 ft.) On each side of the engine are three flash-wheels, having a diameter of 6·60 (21 ft. 8 ins.), and a breadth of 2 met. (6 ft. 6¾ ins.), lying at such a height, that they can even work at spring tides. Their axles are not, as at *Spaarndam*, in a line with the crank axle of the engine, but are moved by spur wheels and pinions in such a proportion that as the engine makes 13½ revolutions per minute (its normal speed) the wheels make 6 revolutions. The axles of the wheels are furnished with coupling-boxes, so that according to a greater or less difference of level, one or more of the wheels may be coupled. To supply steam to this engine there are three cylindrical boilers with internal flues. Diameter of boilers, 1·68 met. (5 ft. 6 ins.); diameter of flues, 1·02 met. (3 ft. 4 ins.); length, 8·53 met. (28 ft.) Above and across these boilers is placed a steam chest, having a length of 6·40 met. (21 ft.), and a diameter of 1·22 met. (4 ft.)

The engine should have been finished in June, 1852, but was not ready until 1853, so that it was not worked until after the drainage of the mere was finished. It has, however, since done good service in discharging the water from the *boezem* of Rhynland. Had it been erected in 1848, it would have contributed much to shorten the time of the drainage. It was constructed by Messrs. Paul van Vlissingen and Dudok van Heel at Amsterdam, for a sum of 79,924 fl. (£6660), while the building was erected for the sum of 94,762 fl. (£7897).

During the drainage of the mere, no unusual wet years occurred; for had such been the case, the engines must have been stopped for a much longer time, in order not to raise the level of the *boezem* of Rhynland too much, which during this time discharged its superfluous water on the points before named. But now, after the drainage, the same necessity for a good discharge exists, and much more than before, for while formerly the superfluous water of 70,000 hectares (173.000 acres) was received on a *boezem*, having an area of 22,700 hectares (54,538 acres), the superfluous water of 88,000 hectares (217,460 acres), has to be received on a *boezem* of which the area is but 5000 hectares (12,356 acres), so that its level is raised in a much shorter time. Therefore, the existing means were considered insufficient to meet unfavorable circumstances, and a sum of 200,800 fl. (£16,600), was allowed for the erection of a third steam engine, equal to that at *Halfweg*, for the discharge of the *boezem.* This engine, which at this very moment is in course of construction, is intended to be placed at *Gouda*, to bring the water on the river *Yssel.* With the aid of these powerful means, there is not the least danger of the district of *Rhynland* being overflowed, for except by the three steam engines, the water is discharged at Katwyk, on the North Sea. The great value of the engines for discharging the *bozeem* may be shown by the statement that during the year 1854, and the first four months of the following year, the engine at *Spaarndam* has raised about 184,000,000 cubic met.; and that at *Halfweg*, in the same time, about 107,000,000, making together a volume of 291,000,000 cubic met. (304,000,000 of tons.) Three great pumping engines have drawn from the mere, which after the drainage is called *polder*, since the 1st July, 1852, unto the 1st May, 1855, 398,000,000 cubic met., being at the rate of 140,000,000 yearly, or 7700 cubic met. per hectare, corresponding with 3067 tons per acre. This gives a height of 0·77 met., rather more than 30 inches for rain and filtration water, which is considerably more than that found by Mr. Glynn, viz.—24 ins. giving 7260 cubic feet per acre and per month, while this height gives 9166 cubic feet. It must, however, not be overlooked, that this quantity will decrease after some years, but the nature of the soil is such that a considerable quantity of water will always percolate through it.

The mere being dry, it remained to be divided, and suitable drains, roads, and bridges had to be constructed. It was a point of consideration to fix the area of each piece enclosed by drains, so that it should not be too small, whereby too much valuable ground was occupied by the drains, and, at the same time, not too great, whereby the drainage might be imperfect. In the earlier drainages by wind-mills, the collective area of the catch-water drains occupied an area of $\frac{1}{10}$—$\frac{1}{12}$th of the whole surface; but in the case of land drained by steam power so great an area is not required, while the drains have not to retain the water until the blowing of a favorable wind, but can be discharged at the rate of their being filled. It was accordingly resolved to divide the land in pieces, surrounded by drains of an area of 20 hectores (49·4 acres), having a length of 1000 met. (1060 yards), and a breadth of 200 met. (212 yards), and lying in the direction from north-west to south-east. By this division but $\frac{1}{32}$ of the whole area is occupied by the drains, the principal canal or drain having a width of 25 met. (82 ft.) runs in nearly a straight line from the *Leeghwater* to the *Lynden* engine, having a length of about 20½ kilomet. (12¾ miles), while another drain of the same dimensions, perpendicular on it, conveys the water to the *Cruquius.* Three drains of smaller dimensions—their width being but 8 met. (26¼ ft.)—run parallel to, and on each side of, this main drain, being crossed by six similar drains, whereby the land is divided into squares, which again being divided longitudinally by roads in two parts, form areas of 300 hectares (741 acres), which by the minor drains are again subdivided in fifteen pieces of 20 hectares, as indicated above. The drains are indicated on the map by straight, thicker or thinner lines—the roads by two parallel lines (=). Except the small drains, dividing the squares formed by the main drains, about 180 kilomet. (112 miles) of drains, nearly 200 kil. of road and about sixty-five bridges have been constructed, of which twelve are over the principal main drain. These works have been executed for a sum of 1,261,199 fl. (£105,099). After this was accomplished, the ground had to be sold, which was done in the three consecutive years, 1853, 1854, and 1855. These sales have produced much more than was expected, 16,822 hectares having been sold for 7,972,400fl. or on an average at the price of 473 fl. per hectare (£16 2*s.* 8*d.* per acre). An area of 32 hectares (79 acres) has been reserved for the building of villages, after a fixed plan, this area being valued at a sum of 7000 fl. (£583.) The quality of the land is not the same in all places, some tracts being of the first, and others of an average quality ; but on an average it is good. For the most part rape seed is cultivated, it being the best crop for newly drained grounds. The crops of 1855 have been excellent, as well as regards quality as quantity.

To complete this description, it only remains to give a review of the total expense. For the drainage was borrowed, a capital of 9,916,344 fl. (£826,362) nominally, but which amounted to no more than 8,429,344 fl. effective, to which were added afterwards, at different periods 552,000 fl. so that the total allowed sums amounted to 8,981,344 fl. (£748,445).

The following table gives the amount of the expenses from 1839 until the end of 1855 :—

	Florins.		£.
1. Works for improving the discharge of the *boezem* of Rynland, viz : the widening of the canal and sluice-gate of *Katwyk*, the improvement of the *Spaarne*, the erecting of the steam-engines at *Spaarndam* and at *Halfweg*, with that in course of construction at Gouda, calculated at 200,000 fl. .	1,289,167	=	107,430
2. Enclosure, embankment, and canal, .	1,988,257	=	165,689
3. Expropriation, . . .	684,514	=	57,042
4. The three steam engines for the drainage of the lake, with the cost of repairs, coals, and wages, until December, 1855,	2,299,523	=	191,627
5. Works in behalf of the navigation—viz: the towing-path along the *Spaarne* and the enclosure canal, with the bridges, improvements of some existing canals, &c., .	133,288	=	11,107
6. Works for the defence of the capital by inundation, .	275,921	=	22,993
7. Works relative to the division of the grounds—viz: the construction of drains, roads, bridges, &c., . .	1,261,199	=	105,100
8. Entertaining and repairs of the different works during the drainage, until the end of 1855, . .	363,751	=	30,314
9. Direction, office expenses, policy, experiments, &c.,	639,477	=	53,289
10. Expenses not provided for, . .	46,247	=	3,854

	Florins.		£.
Whereto are to be added 220,000 fl., which were expended for repairing the drains and enclosure of canal, which, in the winter from 1854-55, had suffered considerably by the banks not then being thoroughly settled, and being soaked, the alternate frost and damp weather, caused a slipping and filling of the drains and canals,	220,000	=	18,333
	9,201,344	=	766,778

The profits may be calculated as follow :—

	Florins.		£.
Sale of the grounds,	7,972,400	=	664,366
Profits of a fund formed by utilizing the money not directly required, and the profits of the grass on the banks being sold until 1853,	932,236	=	77,686
Profits of the grass during 1854, as also from the taxes for keeping the land dry, amounting to 7 fl. per hectare (4*s.* 8*d* per acre),	61,647	=	5,137
The same for 1855,	87,461	=	7,288
Profits from the sale of 32 hectares for building villages, valued at	70,000	=	5,833
Profits of 42 hectares, near the engine the *Cruquius*, valued at	14,700	=	2,225
	9,138,444	=	761,535

This difference between outlay and profits is very trifling, but to it must be added the rent of the first negotiated capital, amounting together to about three and a half million florins (£29,000); so that the total cost for which the Haarlem Mere has been drained, with all the additional works enumerated above, and their repairs, together with the discharging of the superfluous water, during three consecutive years, notwithstanding the drainage has lasted much longer than was expected, has been performed for this comparatively small sum. This sum will be diminished afterwards, when the lands, which, during the first twenty years are free, begin to pay taxes.

Thus, by this extraordinary work—which may be considered as being the greatest of the kind ever performed—a surface of water, which every year invaded a greater portion of its banks, and grew every year more dangerous for the great and rich towns which are situated in its vicinity, has been transformed into valuable crop-growing land, which every year improves in quality and gradually realizes a higher price; so that whilst 18,000 hectares more are now cultivated in the richest part of the Netherlands, adding so much more to the public wealth, a permanent barrier has been formed against the encroachments of the North Sea upon an enormous tract of lowlands situated between the North Sea and the Zeuider Zee. It is attributable to the uncommon skill and energy of the engineers and the Commissioners that this work has been finished with such a success, and they have given to the world an example of what may be done in this way, and how it may be performed in a comparatively short time with but a small amount of capital when judiciously expended. The drainage of the Haarlem Mere is a triumph of science over nature, of which Holland may forever be proud.

Deventer, Holland, February, 1856. H. C. Bosscha, C. E.

AMERICAN PATENTS.

List of American Patents which issued from November 4th, to December 2d, 1856, (*inclusive,*) *with Exemplifications.*

NOVEMBER 4.

1. For *Improved Machinery for Operating the Pawl Cases of a Ship's Windlass;* Christopher Amazeen, New Castle, New Hampshire.

Claim.—" My arrangement of the brake levers, connexion lever, vibratory posts, and two pawl cases, as applied to a post and windlass barrel."

2. For an *Improvement in Cutting Metals;* Robert Anderson, U. S. Army, and Aaron H. Vancleve, Trenton, New Jersey.

Claim.—"The use of the parallel table, revolving table, and traversing table, in connexion with machinery for punching and shearing metals, when the said tables are constructed and operated for cutting and punching straight, curved, or irregular forms in metal."

3. For an *Improved Instrument called an Equatorial Sextant;* William A. Burt, Mt. Vernon, Michigan.

Claim.—"Combining with the common sextant, equatorial and horizontal movements, for the purpose of obtaining latitude, time, azimuth, altitude, and declination, which are read from the instrument without computation. Also, combining the limb which moves over the face of the hour circle with the limbs, by means of the slotted arc, (or equivalent thereof,) and movable bearing and vertical spindle. Also, combining the latitude circle with the limb, by means of the limb, (having its centre of motion on the line,) the arc and bearing, and vertical spindle."

4. For an *Improvement in Odometres;* Albert Carter, Forestville, Conn.

Claim.—" The bearing ring, the catch spring, and the set screws, on which the case containing the movements turn by the action of the carriage wheel, and produces the result of indicating the distance traveled."

5. For an *Improvement in Railroad Car Brake;* William G. Creamer, City of N. Y.

Claim.—"The attachment of a reserve power for applying the brakes in sudden emergencies connected to, and identified with the present brake shaft as used in eight wheel platform cars, and operating in combination with the common bell or signal cord of the train. Also, in combination with the cross bar, with the spring drum, and circles of ratchet teeth, operating in connexion with the vertical brake shaft, or the equivalent of a loose pulley with a double circle of ratchet teeth arranged in the same way, but actuated by a weight or spring. Also, the combination of jointed pawls and disconnecting lever, with the drum for retaining and disengaging the reserved power when required, while the brakes are being operated by hand if necessary."

6. For an *Improvement in Railroad Station Indicators;* Edwin A. Davis, Crawfordville, Indiana.

Claim.—" The bar connected with the pawls and operated by the lever and crank."

7. For an *Improvement in Rocking Chairs;* Martin Eberhard, Philadelphia, Penna.

Claim.—" 1st, The lever, the link and lever, in combination with the seat and adjustable foot rest. 2d, The treadle, its arm and link, in combination with the frame and foot rest. 3d, The crank shaft, the lever and link, in combination with the cross piece and frame."

8. For an *Improvement in Spading Machines;* Ormrod C. Evans, Stantown, Ohio.

Claim.—" The combination of a series of forks or spade blades, with an endless chain, and with a drum and rollers, arranged in such order upon a carriage, that by the progressive onward motion of the machine, the said spades or forks will at first be forced by a direct or nearly direct thrust into the ground, and afterward in the act of being lifted by the chain out of the ground, shall be made to turn at such short angle with the surface, as will cause the breaking and upheaving of the ground."

9. For an *Improvement in Machines for Husking Corn;* Harlan P. Gerrish, Boscawen, New Hampshire.

Claim.—"The use of the hooks, or their mechanical equivalents, arranged and made to operate in connexion with two knives, for the purpose of cutting off the stalk of an ear of corn, and removing the husks therefrom. Also, making the cylinder with the depression."

10. For an *Improvement in Automatic Musical Instruments;* Hiram Groves, City of New York.

Claim.—" 1st, Constructing the barrel of automatic musical instruments of a prismatical form, and by leaving spaces between the bars or rails covering it. 2d, Notching the rails or bars of an organ barrel, and securing in the said rails a wire. 3d, Constructing the tones of automatic musical instruments of metallic segmental plates."

11. For an *Improved Cowl or Draft Accelerator for Steamers;* Peter C. Guion, Cincinnati, Ohio.

Claim.—" The combination of the several devices, surfaces or parts constructively."

12. For an *Improvement in Railroad Car Brakes;* Dennis Harrigan, Winchester, Massachusetts.

Claim.—" The compensation rods, in combination with the levers, or their equivalents."

13. For an *Improvement in Machines for Making Rope;* John Harris, Hoosick Falls, New York.

Claim.—" The method of driving the flyers by arranging them radially to the main or laying spindle, and providing them with rings, or wheels, or their equivalents, to roll in contact with a stationary table, when rotary motion is given to the main or laying spindle, said rings being adjustable to bring them nearer to or further from the centre of the main or laying spindle, for the purpose of varying the speed."

14. For an *Improved Catch for India Rubber Shoes;* Nathaniel Hayward, Colchester, Connecticut.

Claim.—"The use of a steel, rubber, or other kind of spring catch of any proper shape in the heel of an india rubber overshoe or clog, having a projection or lip extending out horizontally, or through the quarter as specified, whereby the overshoe is prevented from slipping at the heel, and is susceptible of being disengaged from the under boot or shoe without using the hand."

15. For an *Improved Fishing Implement;* Elmore Horbon, Bristol, Connecticut.

Claim.—" The spear cross bar notched at each end, in combination with the spring jaws."

16. For an *Improvement in Looms;* Lucius J. Knowles, Warren, Mass.

Claim.—"The combination of a single picker staff, pickers, and boxes, wherein there is a separate picker for each box of the series, and all such pickers are successively moved towards and operated by such single picker staff, during the operation of weaving with the shuttles of the said series of boxes. Also, the improvement in the picker staff when applied to operate a series of pickers, arranged in a set of shuttle boxes as described, the improvement consisting in the bend or recess applied to the picker staff, so as to enable it while operating a picker, to pass by another picker under the former, and not move the said other picker in its box. Also, making the picker staff with a bend or recess, or its equivalent, so as to enable it while operating a picker, to pass by another picker, and not move the same in its box."

17. For an *Improvement in Automatic Rakes for Reapers;* Pells Manny, Waddam's Grove, Illinois.

Claim.—" Pivoting the rake for curvilinear play over the platform, to the up and down moving lever or supporting beam, and arranged to operate together and separately at intervals, in relation to the platform and each other."

18. For an *Improved Burglar's Alarm;* William McClachlan, Assignor to Robert Livingston, City of New York.

Claim.—" The application of a portable alarm (of any construction) to the key, so that the key being in the lock in one position, cannot be interfered with or the position changed without indicating the same by causing an alarm to be given."

19. For an *Improved Lubricator;* James F. Monroe, Fitchburgh, Mass.

Claim.—"The plate and plug, as arranged and combined with each other, and with the lubricating cup."

20. For an *Improved Spring Frame for Packages;* Henry B. Osgood, Dorchester, Massachusetts.

Claim.—"The arrangement of the protector frame, in relation to the box or other receptacle, and its combination therewith, by means of the elastic fastenings, or their equivalent."

21. For an *Improved Joint for Uniting a Mortising Chisel to its Mandrel;* Joseph R. Perry, Port Clinton, Pennsylvania.

Claim.—"Securing the revolving chisel socket to the cross-head or cap, by grooving both, and filling the annular space thus created with a metallic composition."

22. For an *Improvement in Trowels;* L. D. Phillips, Chicago, Illinois.

Claim.—"1st, The open bottomed chamber provided with flanches or trowels. 2d, The adjustable gauges as applied to my trowel. 3d, The general arrangement of the follower and its appendages, viz: springs, guide or brace, and handle."

23. For an *Improvement in Cotton Gins;* Wilson A. Purdom, Jackson, Miss.

Claim.—"1st, Giving to the cotton to be ginned within the feed box, and before the saws, a reciprocating motion by means of the corrugated cylinder, or a modification of such cylinder and the corrugated apron, or either of them separately, or their equivalents, so that the cotton will pass back and forth slowly in bulk, or nearly so, before the saws, thus presenting a fresh surface to the action of the saws, throughout the entire length of the saw cylinder, without having any of the saws idle, and without the accumulation of seed at one end of the box, or the banking up of the cotton at either end. 2d, The said cylinder or its equivalent, whether it is placed within or outside of the cotton roll, and whether it is permanently attached to the apron or not, also whether it revolves or not, or whether that revolution is continuous or intermittent. 3d, The corrugated apron, or its equivalent, whether it is operated conjointly with the said cylinder or not."

24. For an *Improvement in Machines far Husking Corn;* Joshua Perkins, West Killingley, Connecticut.

Claim.—"The improvement of so operating the two cutters or chisels, that during their descent into the stalk of the cob, they may pass into it in contact with each other, so as to pierce but one hole, and thereafter receive a lateral motion simultaneously in opposite directions, so that while one chisel or cutter is made to discharge the husk from the machine, the other is caused to discharge the ear therefrom."

25. For an *Improvement in Chain Pumps;* John Robingson, New Brighton, Penna.

Claim.—"Providing the wheel, having its buckets and chains arranged as described, with a partition forming troughs, and tilting stops or bars arranged relatively to each other, and rotating together with the wheel and its buckets for operating together."

26. For an *Improvement in Hay Rakes;* Thomas R. Roach, West Needham, Mass.

Claim.—"The springs above and below the teeth."

27. For an *Improvement in Sewing Machines;* S. H. Roper, Roxbury, Mass.

Claim.—"1st, A thread guide, which guides the thread into the eye of the needle, by means of the projection, and the thread holder forming a thread clamp, and griping and holding the thread between them, while the thread guide with its clamp revolves until the thread is wrapped partly round it and stretched across the aperture therein. And, then also, by means of the thread guide with the thread thus held, moving laterally, until in this manner, and by means of these rotary and lateral motions, the thread is effectually guided into the eye of the needle. 2d, The working of eyelet holes in cloth or other material, by means of a rotary feed motion combined with the slotted tube and two needles."

28. For an *Improved Method of Starting and Stopping Water Wheels;* David M. Tyler, Lisle, Massachusetts.

Claim.—"The combination of the frame upon the main shaft, and the spring dog on the same, with the notched disk, and the rods leading to the swinging buckets, or their equivalents, for effecting the opening of the issues and locking of the same. Also, the beveled disk, in combination with the studs of the dog, or their equivalents, arranged and operating for permitting the water in the wheel to close the issues."

29. For an *Improvement in Throstle Spinning Machines;* Joel Smith, Northbridge, Massachusetts.

Claim.—"Regulating the twist of the yarn in ring spinning machines, by communicating a gradually accelerated motion, (proportionate to the gradually increasing diameter of the bobbins) to the rolls which give out the yarn to the bobbins."

30. For an *Improvement in Weaving Long Warps;* John C. Smith, New Hartford, Connecticut.

Claim.—"A box, in combination with the arrangement for dispensing with the warp beam, for the purpose of laying the warp in a regular smooth succession of layers evenly, that the box may give out the warp free from twists and tangles."

31. For an *Improvement in Sewing Machines;* Isaac M. Singer, City of New York.

Claim.—"Operating the needle to give it the required reciprocating motions, by a crank pin or roller on a rotating shaft, acting in a cam groove, whereby the required motions are imparted to the needle with much less extent of motion of the crank pin or roller in the cam groove, and consequently less friction, than if the cam groove were on the shaft, and the pin or roller on the needle carrier. Also, projecting the operative part of the surface of the feeding apparatus through the surface of the table, so that such feeding surface may act on a portion of the under surface of the material to be sewed, to give the required feeding motion to space the stitches, while the other portion of the said material slide on the table, which answers the purpose of stripping the said material from the feeding surface, and to cover and protect the mechanism which operates the feeder. Also, imparting the feeding motion to the feeder, to present the material to be sewed to the action of the needle for spacing the stitches, by griping the periphery thereof, or any equivalent therefor, by a griping lever in contradistinction to the action of a pawl or hand catching on to ratchet teeth, whereby the extent of feeding motion may be adjusted and varied to any degree, instead of being restricted by the size of ratchet teeth, and whereby also, I avoid the wear and liability to derangement incident to the use of a ratchet motion. Also, in combination with the feeder attaching the presser, for controlling the material to be sewed, and holding it to the surface of the feeder to a slide, or its equivalent therefor, so that the plane of its under surface shall always bear the same relations to the plane of the table in a line at or nearly at right angles to the line of the seam, whether the material to be sewed be thick or thin."

32. For an *Improved Apparatus for Heating or Cooking by Gas;* William F. Shaw, Boston, Massachusetts.

Claim.—"Combining with the wire gauze or perforated tube, and the air and gas burner, an air guide or concentrator applied thereto."

33. For an *Improvement in Stirrups for Riding Saddles;* Richard Trussell, Brooklyn, New York.

Claim.—"The attachment of the foot piece to the bow of the stirrup by a shaft, or other connexion of a similar character, furnished with a spring."

34. For an *Improved Machine for Sawing Marble and Stone;* George J. Wardwell, Hartley, Canada.

Claim.—"Suspending the swinging saw frame from levers, when arranged as described, and constructed with or without the circular bearing surface, resting on the friction roller or rollers, in the end of the vertical lever or levers attached to, and swinging with, the swinging saw frame."

35. For *Improved Self-Acting Head and Tail Blocks for Sawing Mills;* A. S. Walbridge, Burlington, Vermont; patented in Canada, July 28, 1853.

Claim.—"The combination and arrangement of the T shaped carriage blocks, connecting rack, and setting off shaft, whereby a self-operating carriage of any desired length or compactness is produced. Also, the self-setting off device, composed essentially of the ratchet, disks, adjusting stop, and stationary cam."

36. For an *Improved Drain Tile Machine;* Thomas Maycock, Assignor to self and Henry Rice, Buffalo, New York.

Claim.—"The combination of the annular ring, with the plunger, the latter having a smaller diameter than the ring and cylinder."

37. For an *Improvement in Fabric for Underlaying Carpets;* William S. Pratt, Assignor to J. S. C. Thursby, Brooklyn, New York.

Claim.—"The cellular paper or paper board, for the purpose of underlaying carpets on floors."

38. For an *Improvement in Power Looms;* Alexander Smith and Halcyon Skinner, West Farms, New York.

Claim.—"1st, Mounting the yarns for formimg the ranges of tufts in parcels, on a series of spools or equivalents therefor, in the order required for producing the design or pattern required, so that each spool, or the equivalent therefor, may be brought in succession to the required position for each range of tufts. 2d, The mode of operation by which the spool frame required at each operation is brought down in close proximity with the tufting warps, and then carried out of the way of the lay when performing its operations. 3d, The mode of operation by which the tufts of yarn are introduced and applied to the tufting warps. 4th, The mode of operation by which the tufts are cut off from the yarns after they have been introduced and applied to the warps. 5th, The mode of operation, by which the tufts are carried to the required place in the fabric, by the combined action of the reed and plate, or any equivalent therefor. 6th, And in combination with the several modes of operation by which the tufts are introduced, the employment of the heddle motion, for binding and holding the said tufts by the warp threads."

39. For an *Improved Shutter Fastener;* David M. Lawrence, Cincinnati, Ohio.

Claim.—"A lock plate, when constructed with a semi-circular flanch, having a series of notches cut therein, in combination with the spring stop and hinge."

40. For an *Improvement in Crushing Rollers for Ores, &c.;* William H. Plumb, City of New York.

Claim.—"The construction, combination, and arrangement of the stationary and movable rollers, adjusted to the work to be done."

41. For an *Improvement in Cider Mills;* Benjamin Mackerly, New Petersburgh, O.

Claim.—"The combined use of flat sided saw edged teeth upon the cylinder and within the concave."

42. For an *Improved Tool for Tenoning, &c.;* Alfred Tippet, Washington, D. C.

Claim.—"So making of the chisels adjustable in the stock, as that they may be made to cut also a dove-tail tenon with the same tool, and without reversing the same, and so that said tool may be used in any ordinary mortising machine, and thus avoid the expense of two machines."

NOVEMBER 11.

43. For an *Improvement in Bumper Brakes for Railroad Cars;* Francis Armstrong, New Orleans, Louisiana.

Claim.—"The employment of the yielding force, made by the pull on the cars, to adjust the apparatus, and place it in position, that the force acting by the cars coming in contact with each other, will secure that force to act on the brakes, and close them on the wheels, and the force made by the pull on the cars when allowed to re-act, reversing the position of the apparatus, in the placing it so that the pressure of the cars acting against each other, can operate on the apparatus, and have no action on the brakes."

44. For an *Improved Anti-frost Faucet;* Frederick H. Bartholomew, City of N. York.

Claim.—"The application of a waste way to draw cocks."

45. For an *Improved Steam Drag;* George Bradley, Paterson, New Jersey.

Claim.—"The arranging of the driving wheels of a steam carriage in a truck frame that can turn independent of the engine frame, and so that the engine frame shall follow or be drawn by the truck frame, instead of the latter being controlled by the former, as has heretofore been done. Also, transmitting the power of the engine to the driving-wheels in the truck frame, so arranged through the swiveling point or axis of the truck frame, as that there shall be no cramping or twisting of the frames or connecting rods."

46. For an *Improvement in Steering Apparatus for Ships;* Thomas Carr, Liverpool, England.

Claim.—"The application to the ordinary steering apparatus of vessels, of a crank, or its mechanical equivalent, the eccentric working, in combination with an entire pulley or its segment, a quadrant on a vertical axis, the whole being interposed as a medium of communication between the wheel ropes or chains and the tiller."

47. For an *Improvement in Draining Machines;* John Cole and A. Little O. Wall, De Witt, Illinois.

Claim.—"1st, The combination of the brace coulter, and rotating coulter, with the mole. 2d, Constructing the mole in sections flexibly connected together. 3d, Constructing the mole with a fin or knife on its sole, to make a deep furrow in the bottom of the drain to facilitate the entrance of the water from the adjacent soil."

48. For an *Improvement in Fastening Door Knob Spindles;* Almon Cooley, Assignor to Roderick Terry and A. Cooley, Hartford, Connecticut.

Claim.—"The conical slide, when combined with the spindle and knob."

49. For an *Improved Door Fastener;* Legrand Crofoot, Syracuse, New York.

Claim.—"Combining the two plates with the spring bolt of the plate and the eye hook of the plate."

50. For an *Improved Diaphragm Fluid Metre;* J. Henry Darlington and Wm. Piper, City of New York.

Claim.—"The particular arrangements of the elements or devices."

51. For a *Sleeve Fastener;* John P. Derby, Cavendish, Vermont.

Claim.—"Arranging and combining with a face plate by means of a post or stem, a cross-bar or plate, which, with proper construction, admits of the insertion of a stem or stems into the holes of a wristband or cuff, and is then secured in place by means of slots in the plate that revolves until the stems are entered therein. Also, the spring which serves to keep said stems in place in the slots, and which prevents the face plate from being turned until its force is overcome. Also, combining with the stem of the face plate, and the cross-bar, two sets of cams, whereby the distance between the stems of cross-bar and face plate can be graduated to receive the wrist-band at pleasure, and whereby the distance that the face plate and cross-bar traverse in opposite directions may also be controlled, the whole making a perfect and safe fastener."

52. For a *Sugar Draining Apparatus;* Gustavus Fincken, Brooklyn, New York.

Claim.—"The employment for the reception of the moulds of a wheel carriage, composed of a box or vessel, with seats to receive the moulds, and a frame to keep them upright, and with stoppers so applied within the box or vessel, as to enable several to be inserted in, or withdrawn from, their respective moulds simultaneously by a crank, or its equivalent, at one end or side of the carriage."

53. For an *Improvement in Machines for Harvesting Grain;* George F. Foote, Buffalo, New York.

Claim.—"The peculiarly constructed scroll cylinder, in combination with the cylinder case, and the gathering wheels, when the same are constructed and arranged to operate in relation to each other and the main frame."

54. For an *Improved Spring Holder for Slat Blinds;* William L. Gallaudet, City of New York.

Claim.—"The combination of the peculiarly shaped spring, with the rod and with the lower rail."

55. For an *Improvement in Water Gauges for Steam Boilers;* John C. Harris, Savannah, Georgia.

Claim.—"The arrangement of the float chamber, the stop-cocks, and the blow-off cocks, to adapt the gauge to the employment of oil, interposed between the float and the water to carry the float."

56. For an *Improved Method of Regulating the Draft of House Furnaces;* Samuel L. Hay, Reading, and Henry B. Osgood, Dorchester, Massachusetts.

Claim.—"The compound valve with the spring, or its equivalent, and equipoise, in combination with the pipe."

57. For a *Candle Mould Machine;* August Hengstenberg, Muscatine, Iowa.

Claim.—"The combination of the spools as constructed in my machine, with their gearing and locking. Also, the securing of the cutter by means of the layer."

58. For an *Improvement in the Cutting Apparatus of Grain and Grass Harvesters;* Moses G. Hubbard, Penn Yan, New York.

Claim.—"The combination of a single cutter with a double cutter, and made to reciprocate in directions opposite to each other."

59. For an *Improvement in Forks for Handling Heated Plates;* G. W. Hyatt, Auburn, New York.

Claim.—"The clamp or spring, for the purpose of supporting the tines, and also to allow them to be adjusted to suit articles of different diameters."

60. For an *Improved Method of Ventilating Ships, &c.;* Rudolph Knecht, City of N. Y.

Claim.—"The combination and arrangement of two sets of wings on one shaft, acting simultaneously, so that while one is expelling the foul air, the other will draw in fresh air."

61. For an *Improvement in Wagons;* Henry Kruse, New Orleans, Louisiana.

Claim.—"The application to wagons of wheels made buoyant by the use of disks that will cause the wagon to be supported in water from such buoyancy; with the application of propelling blades on said wheels, to cause the wheels to be available in propelling the wagon in water, and the same wheels, by removing the propelling blades, can change the wheel so that they are available in their uses in the transporting of substances on land similar to common wheels of wagons."

62. For an *Improved Waste Valve for Hydrants;* Robert Lawson, St. Louis, Mo.

Claim.—"The interior arrangement and combination of water valve and air chamber. Also, the peculiar combination of an air chamber with the waste valve."

63. For an *Improved Method of Hanging Reciprocating Saws;* George D. Lund, Yonkers, New York.

Claim.—"Placing or fitting the rod or shaft, to which the lower strap or socket is attached, loosely in the slides."

64. For an *Improved Method of Preparing Ratan for Umbrellas;* James W. Martin, Philadelphia, Pennsylvania.

Claim.—"The combined devices for forming and tipping the ratan or whalebone for umbrella ribs."

65. For an *Improvement in Cutting Files;* Charles Miller, City of New York.

Claim.—"Fitting the chisel to work in a stock which rests upon the file blank itself, or on a pattern of similar form moving with it throughout the whole length of the movement of the blank under the chisel, and serves as a stop to the chisel."

66. For an *Improvement in Clothes Dryers;* Samuel Morrill, Andover, N. H.

Claim.—"Arranging the ratchet on the under side of the reel, in combination with the pawl and lever, in such a manner that the pawl and ratchet are brought into play when the reel is tilted, but thrown out of play when in its horizontal position."

67. For a *Medical Respirator;* Edwin M. Murphy, Lexington, Illinois.

Claim.—"The combination with the usual medical inhaler of a fan, to be revolved by the act of inhalation."

68. For an *Improvement in Machines for Slicing Apples;* Ephraim L. Pratt, of Philadelphia, Pennsylvania.

Claim.—"Attaching the knives to a reciprocating piece, by means of pins or axes on which they can so rotate, in combination with the straight rod or guide, for the purpose of causing the knives to descend through the apple in lines parallel to its axis."

69. For an *Improvement in Washing Machines;* Ira Reynolds, Republic, Ohio.

Claim.—"The arrangement and combination in washing machines, of the reciprocating pulleys, springs, and plungers."

70. For a *Process for Cleaning India Rubber;* T. Sault, Seymour, Connecticut.

Claim.—"The cleaning of india rubber by means of the serrated sided teeth, and stationary serrated sided bars, constructed and arranged to operate in combination with each other."

71. For an *Improvement in Breech-Loading Fire Arms;* Gustave Scharffe, City of New York.

Claim.—"1st, The manner of cocking the hammer by the opening of the breech. 2d, The arrangement and construction of the hammer. 3d, Screwing the breech cap, either upon or into the gun barrel, said breech cap being provided with a hole corresponding with a hole in the gun barrel, by the unscrewing of which said breech cap, the hammer is cocked, and both holes are brought above each other so as to admit the cartridge, while, by the screwing up of said breech cap, the hole in the gun barrel is closed up again."

72. For an *Arrangement of Means for Heating Feed-water of Locomotive Engines;* John R. Sees, City of New York.

Claim.—"The construction of the duplicate cylindrical coils, and their arrangement in relation to the smoke box, the exhaust pipes, the tubes, and the base of a smoke stack of a locomotive boiler."

73. For an *Improvement in Breech-LoadingGuns;* Christian Sharps, Philadelphia, Pennsylvania.

Claim.—"The combination and arrangement of a spoon-formed cartridge piercer. with the turning breech pin of a breech loading fire arm, whereby the powder is more effectually worked into the channel leading to the primer, by the operation of locking the breech pin in its place. Also, the combination of a removable brush and elastic packing ring with the breech of a fire arm."

74. For a *Gas Regulator;* W. G. Sterling, Bridgeport, Connecticut.

Claim.—"The vibrating balance, with the partition, forming two chambers, and extending into said balance, which is so adjusted that it vibrates in the two chambers, and is connected with a valve in any suitable form."

75. For an *Improvement in Mill Stone Dress;* Thomas B, Stout, Keyport, N. J.

Claim.—"The combined arrangement of furrows upon the grinding plates, viz: the inner furrows, having their abrupt edges on the two grinders, meeting by the revolution of the runner deep at the central ends, but running out to the surface at the outer ends, while the peripheral furrows are arranged oblique to the inner furrows, their edges inclined in the opposite direction, and having a considerable proportion of plane surface between them."

76. For a *Copper Ring for Gas Retort Fastening;* William H. St. John, City of N. Y.

Claim.—"1st, The tightening with copper, of the joints of doors of gas retort heads, when the said joint is effected by the otherwise usual groove inserted in the flanch of the mouth piece, to meet a corresponding projection on the door. Also, the placing a hot air chamber beneath the mouth piece, to consume the tar and oil collecting on the bottom of the latter."

77. For an *Improved Projectile for Fire Arms;* William Taggart, Haverhill, Mass.

Claim.—"The spiral partition. Also, the wings."

78. For an *Improved Weather Strip for Doors;* Reuben Wight, Westfield, N. Y.

Claim.—"The adjustable weather strip, operated by the segment lever, in connexion with the movable button and the cams."

79. For an *Improvement in Machines for Cutting Vegetables;* Jacob Geiss and Jacob Brosius, Belleville, Illinois.

Claim.—"The cone, provided with slots and secured upon the shaft, in combination with the knives attached to the arms and disk."

80. For an *Improvement in Harvesters;* Alvin Bullock, Busti, New York.

Claim.—"Operating the sickle bar by means of the right angled lever on the shaft. in combination with the lever, bar, and flanch, when the same are constructed and arranged to operate in relation to the main frame, drive-wheel, and adjustable finger bar."

81. For an *Improvement in Machines for Paring Apples, Potatoes, &c.;* Ephraim L. Pratt, Philadelphia, Penna., Assignor to Leonard Harrington, Worcester, Mass.

Claim.—"1st, Moving the apple, potato, or other object, in a direct line past the knife, or the knife past the object, during the revolution of said apple, potato, or other object, by means of the screw shaft, and cogged rack, whereby the operation of paring is performed by the turning of the screw shaft, without any other movement of the knife than that occasioned by the curvature, size, and inequality of the surface or form of the article being pared, to which the said knife is accommodated by the action of the spring. 2d, The peculiar form of the knife—that is to say, shaping the portion nearest the shaft of the form of a segment of a circle of a given radius, and the remaining portion farthest from the shaft of such curvature as will form a segment of a cycloid of a circle, combined with the first portion, and correspond, or nearly so, with the spiral curve of the screw, when the end of the apple, potato, or other object, is being pared, in such a manner as to enable its edge to assume at all points of contact with the potato, or other object, a convex curve, the reverse of the convex part of said apple, potato, or other object, with which it is in contact, and thereby enable its end and every inequality of its surface to be pared by thus accommodating the edge of the knife to these parts."

82. For an *Improvement in Excavators;* John F. Willey, Fredonia, Assignor to self, B. F. Merrill, and Thomas Phillips, Cassadaga, New York.

Claim.—"Forming the scoop of two parts connected by joints or links, the bottom of the scoop being formed of slots which are allowed to turn, the scoop being suspended to the cart."

83. For an *Improvement in the Manufacture of Iron and Steel;* Henry Bessemer, London, England; patented in England, February 12, 1856.

Claim.—"The conversion of molten crude iron, or of re-melted pig or finery iron into steel, or into malleable iron, without the use of fuel for re-heating or continuing to heat the crude molten metal, such conversion being effected by forcing into and among the particles of a mass of molten iron, currents of air or gaseous matter, containing or capable of evolving sufficient oxygen to keep up the combustion of the carbon contained in the iron, till the conversion is accomplished."

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84. For an *Improvement in Smelting Iron Ore;* Henry Bessemer, London, England; patented in England, August 25th, 1856.

Claim.—"The obtaining from a charge of ore in a furnace, viz: by means of molten iron underlying such charge, and by air, oxygen, steam, or a gas containing oxygen forced into the molten iron, to such extent as to effect the reduction of the charge, or the abstraction of the metal therefrom, without the employment of ordinary carbonaceous fuel."

85. For an *Improvement in Attaching Centre Boards to Vessels;* George S. Burrows, Mystic River, Connecticut.

Claim.—"The hanging of the centre board to a movable post, or other sliding piece of similar character, which admits of its being easily and readily removed from the trunk for repairs or any other purpose."

86. For an *Improvement in Machinery for Polishing Glass;* Phineas Burgess, City of New York.

Claim.—"The employment and use of grooves arranged eccentrically upon the polishing bed, in combination with the cranes and frames."

87. For an *Improvement in Machines for Sawing Marble;* Wm. Dobson Gallaher, Bensalem Township, Pennsylvania.

Claim.—"The frames, and the mechanism connected therewith, when constructed and arranged to operate in relation to each other."

88. For an *Improved Burglar Proof Safe;* Richard G. Holmes and W. H. Butler, City of New York.

Claim.—"The loose fitting pieces, applied to be received partly in a rebate in the door, and partly in a groove in the door frame."

89. For an *Improvement in Machines for Cleaning Grain;* Chase B. Horton, Elmira, New York.

Claim.—"1st, The double-acting V shaped distributer, in combination with the concentric ring guard, for the purpose of distributing the grain to the periphery of the cylinder while falling, and preventing its return in the blast. 2d, The construction and arrangement of the double blast head. 3d, The combination of the spring partition with the spring valve, so arranged that the expansion of the blast tube by means of said partition shall cause the valve to open, and thereby admit air above the mouth of the tube."

90. For an *Improved Spring Latch and Lock;* William A. Ives, New Haven, Conn.

Claim.—"The securing the bolt on the inside, when the same key serves to turn back the bolt, and also to hold it back when desired, and when the said key, or any additional key used, is so constructed and arranged that it will swing or turn entirely within the tube or cylinder."

91. For *Lee-boards for Vessels;* Augustus Jouan, San Francisco, California.

Claim.—"The elastic metal blade lee-boards, which I call ship-fins, to the sides of ships, vessels, and boats, in a position nearly vertical."

92. For an *Improvement in Propeller Shafts;* Augustus Jouan, San Francisco, Cal.

Claim.—"A propeller shaft, which in its construction is circular, conical, and angular, with these three conditions combined or otherwise, and to be applied vertically."

93. For an *Improvement in Combined Steam Boilers and Kettles;* Allen Lapham, Assignor to self and Stephen Wilkes, Brooklyn, New York.

Claim.—"The use of the kettle, surrounded by steam, in connexion with the boiler, the reservoirs, with valves (or their equivalents), on the upper and lower sider, and the induction pipe."

94. For an *Improvement in Bedstead Fastenings;* Spencer Lewis, Tiffin, Ohio.

Claim.—"The inclined pin passing through post and tenon, in combination with the segmental guard and stud."

95. For an *Improvement in Melodeons;* La Fayette Louis, Boston, Mass.

Claim.—"1st, The use of a long valve or valves, placed over the reeds and under the swell, and vibrated in such a manner by any proper arrangement of mechanical devices as to break and vary the force of the air passing through the reeds, thereby producing a sound similar to the 'tremolo' in the human voice. 2d, Actuating the 'tremolo' valves, so as to impart to them a vibratory movement by means of the fan wheel and crank, or their equivalents, made to revolve by a current of air passing through the box to the bellows."

96. For an *Improved Stave Jointer;* Barnet McKeage, Accotink, Virginia.

Claim.—"The device for automatically jointing staves of different widths to the proper bulge, consisting essentially of the pattern plates and the guiding slots, or their equivalents, respectively set at such different angles as to separate the two ends of said pattern plates unequally and exactly in proportion to the bulge required."

97. For an *Improvement in Cotton Gins;* C. A. McPhetridge, St. Louis, Missouri.

Claim.—"1st, The friction spools, arranged in combination with the saw. 2d, The breast plate, in combination with the spools."

98. For an *Improved Binder for Grain Harvesters;* C. A. McPhetridge, St. Louis, Missouri; ante-dated, October 25th, 1856.

Claim.—"The combination of the reciprocating arm, with spring pliers attached, with stationary arm, revolving twister, cutting plate, friction brake spring, and removable plate, when the same are constructed and arranged to operate in relation to each other and the main frame and driving wheel, for the purpose of binding grain from a continuous coil of wire."

99. The notice of this patent is postponed for the present, at the request of the patentee.

100. For an *Improvement in Lubricating Car Axle and other Journals;* Pierre E. Proust, Orleans, France; patented in France, April 15th, 1853.

Claim.—"The application to greasing or lubricating apparatus of axles, shafts, and other rotating portions of carriages and of machinery, of an air tight reservoir containing water, which being heated by the friction of the rotating portion, is caused to pass through a siphon into the box containing the lubricating matter, and there to mix with it."

101. For an *Improved Bleaching Process;* Julius A. Roth, Philadelphia, Penna.

Claim—"Aiding the action of the usual bleaching agents, by the application of atmospheric air."

102 For an *Improved Boring and Mortising Machine;* G. H. Stevens, Lowell, Wis.

Claim.—"Attaching the auger or bit, chisel, and hammer, to the sliding frame, and operating the auger or bit, hammer, and frame."

103. For a *Tail-piece for Violins, &c.;* Charles M. Zimmerman, Philadelphia, Penna.

Claim.—"1st, The tail-piece, with its recess and loose cover. 2d, The employment of the pins for securing the strings by a single fold to the tail-piece."

104. For an *Improvement in Grain Separators and Conveyers;* Joseph Lyndall, Santa Clara, California, Assignor to Cyrus Roberts, Bellville, Illinois.

Claim.—"1st, Suspending the conveyer on vertical radius bars or pendulum bars, which swing it forward first in a nearly horizontal, and next in an upward direction, and then swing it back, first moving it suddenly downwards, and next horizontally or thereabouts, until it reaches the place whence it started. 2d, Swinging and rocking the conveyer on radius bars of unequal lengths, which raise its rear end somewhat further and faster than its front end. 3d, Arranging the head of the vibrating shaking fingers in a recess in the bottom of the conveyer. 4th, The combination of an adjustable bar or guide, with an arm projecting from the head of the vibrating fingers, so that the upward throw of the fingers may be varied while the limit of their descent remains unchanged. 5th, Constructing the screening apertures in the bottom of the conveyer, with channels on the front sides of the tops thereof, to facilitate the separation of the grain and chaff from the straw, and the passage of the straw through the conveyer."

105. For an *Improvement in Machines for Paring Apples;* Charles P. Carter, Ware, Assignor to Leonard Harrington, Worcester, Massachusetts.

Claim.—"The semi-cylindrical holder, for the purpose of holding and coring the apple. Also, the peculiar form and arrangement of the spring, for the purpose of throwing back the carriage, and operating with an equable pressure during the whole of the progress of the knife."

106. For an *Improved Device for Governing the Parallel Yielding of Lumber Feeding Rollers;* Josiah B. Pomroy, Chicago, Illinois.

Claim.—"The arrangement and combination of the parallel arms, central guiding rod and spring, in connexion with the yielding feeding rollers, mounted on sliding carriages."

107. For an *Improvement in Tailors' Pressing Machines;* C. W. Williams, Boston, Massachusetts.

Claim.—'Suspending the iron or goose from a convex disk, which turns freely upon a ball and socket joint, or its equivalent, and which forms a bearing for the lever to act against."

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108. For an *Improvement in Machines for Stuffing Horse Collars;* Joseph Albright, Greenville, Tennessee.

Claim.—"The intermittently revolving toothed feed wheels, when arranged at the back and on the outside of the hopper, in combination with the crooked fed straw retaining spaces, or chamber, at the bottom of the hopper, and extending backwards, the teeth of the wheels (which work from the outside at the rear into the hopper), urging the slip of the straw down the inclined rack or back of the hopper, and feeding it into the retaining spaces to wait the action of the plunger."

109. For an *Improved Lathe for Cutting Fluted Mouldings;* James Anderson, John McLaren and John Bryant, City of New York.

Claim.—" 1st, The adjustable rotating cutters attached to shafts, which are fitted in frames, the frames being fitted and working in pendent guides attached to the adjustable block. 2d, Placing the leg between centres, which are attached to a swinging frame fitted on a reciprocating carriage ; the leg being turned or rotated between its centres as the carriage moves by means of the inclined slot in the ledge or plate, and the lever and gearing."

110. For an *Improvement in Printing Presses;* F. L. Bailey, Boston, Mass.

Claim.—" The combination of the stationary bed with the revolving distributing cylinder, when the two are so placed within the circle of revolution of the ink rolls. Also, the impression lever, in combination with the connecting bar, when the two are so arranged that they may be disconnected at pleasure."

111. For an *Improvement on Fourneyron Turbine Wheel;* Stephen K. Baldwin, Gilford, New Hampshire.

Claim.—" The extending of the bucket of the Fourneyron turbine water wheel further inward towards the centre of the wheel (either on the radial lines, or on lines varying either side of the central point), and thence upward and outward, so as to receive the direct action of the propelling water against the extended bucket on the outside of the wheel, and above the Fourneyron turbine part."

112. For a *Process of Treating Feldspar for a Manure;* Charles Bickell, Baltimore, Maryland.

Claim.—" The decomposing of feldspar by heating it with lime and phosphate of lime, for the purpose of obtaining potash or soda either in the caustic or carbonated state, and for the purpose of obtaining a manure."

113. For an *Improved Alcohol Cooking Apparatus;* Thomas G. Clinton, Washington, District of Columbia.

Claim.—" An alcohol burner, arranged in its several parts, or in any equivalent manner, irrespective of the method by which alcohol is supplied to the chambers. Also, the internal pipe, or its equivelent, arranged in relation to the tube."

114. For an *Improvement in Boxes and Axles, Journals, &c.;* David Cumming, Sorrel Horse, Pennsylvania.

Claim.—" The V collar or bearing, running in a V groove, and the construction of the box in two separate parts with the oil receptacles."

115. For an *Improvement in Machines for Polishing Leather and Harness;* William Crane, Brooklyn, New York.

Claim.—" The suspended triangular swinging frame, having a socket or receiver attached at one end, and a pitman or connecting rod at the opposite end ; the whole forming an equal balance, giving a steady motion to the machine in operation."

116. For an *Improvement in Curry Combs;* Evan L. Evans, Providence, R. I.

Claim.—" Constructing the curry comb with an elastic or flexible back, formed of india rubber, and securing the teeth permanently in the back by having the india rubber which encompasses the teeth project from the face of the back in the form of ridges, and cones projecting to the point of the teeth."

117. For an *Improvement in Backgammon and Checker Boards;* Edwin O. Goodwin, Bristol, Connecticut.

Claim.—" The construction of draught boards with the indentations on the face, the raised divisions in the backgammon part, and the drawers for the pieces, all in combination."

118. For an *Improvement in Manufacturing Cotton Yarns;* George G. Henry, Mobile, Alabama.

Claim—" The combination of the gin and 'preparation,' that is to say, the arrangement of the cotton gin, in immediate connexion with, and to operate in combination with the spreader or lap machine of any desired construction, so that the gin and spreader combined, shall operate in a regular sequence with the carding and drawing, and other spinning machinery."

119. For an *Improvement in Lathes for Planing Metal;* William W. Hubbard, Boston, Massachusetts.

Claim.—"Arranging the tool carriages, slides, or supports, on the vertical sides of the frame or bed, in combination with arranging above such slides, and so as to project from the sides of the frame and over the slides, covers or guards, whereby the slides are protected from dust, chips, or other matters."

120. For an *Improvement in Stitches for Sewing Machines;* A. F. Johnson, Boston, Massachusetts.

Claim.—"Making a stitch of a single thread, by throwing a shuttle and thread through a loop formed from the shuttle thread, thereby tying or knotting each stitch for the purpose of uniting pieces of cloth or other material to be sewed."

121. For an *Improved Machine to Aid in Making Spokes by Hand;* Edward Julier, Sharon, Ohio.

Claim.—"The construction and arrangement of the pattern cam-gauge device, the jointed lever device, the collar shank, and spring pawl, when operated by the pedal, or its equivalent, together and with the stop or dog and ratchet. Also, the graduating straddle gauge, and hinged or jointed forming gauge rest, with the graduating set plate and yoke devices, with the knife shields or buffer heads."

122. For an *Improvement in Turning Circles for Carriages;* George Kenney, Milford, New Hampshire.

Claim.—"An annular box plate composed of two circles, one attached to the head block or rocker, and the other to the axle, and so constructed as to form a box for excluding dirt and grit from the bearing surfaces of the circular plates, in which box is inserted a washer of oiled leather, the box serving to exclude all dirt and grit from the bearing surfaces, and thereby preventing their rapid wear, and the leather washer preventing the squeaking noise and friction common to all other modes of connecting turning circles, and preventing the jar which would otherwise be occasioned by two metallic surfaces striking together. Also, combining with a 'circle,' a rubber or other elastic friction roll upon which the said circle turns, to lessen the friction and noise, and diminish the wear."

123. For an *Improved Machine for Turning Boot Legs;* M. C. Chamberlin and W. Filkins, Sheldon, New York.

Claim.—"The expansion tube, the rim follower, encircling said tube, the disk-plunger, provided with hooks, and operated inside of said tube, in combination with racks and pinion, for the purpose of imparting adverse longitudinal motion to said rim follower and disk plunger."

124. For an *Improvement in Fire Arms;* Alexander Le Mat, New Orleans, La.

Claim.—"The combination and arrangement of the hammer and finger with the mechanism, whereby the retrograde movement of the hammer, after the ignition of the primer, produces an automatic closing of the vent by the finger."

125. For an *Improvement in Traveling Trunks;* Samuel W. Phelps, Cincinnati, Ohio.

Claim.—"The arrangement of drawers, partitions, and side-lids or doors, for the combined purpose of security, orderly arrangement, and accessibility of all the contents in a traveling trunk."

126. For an *Improved Apparatus for Exhausting Air from and Hermetically Sealing Cans and Vessels;* Aurelius M. Purnell, Washington, D. C.

Claim.—"The apparatus."

127. For an *Improved Disk for Shelling Corn;* Jeremiah P. Smith, Hummelstown, Pennsylvania.

Claim.—"The annular concave shelling surface on the face of the shelling disk, when employed in combination with the other parts of the machine."

128. For an *Improvement in "Edge-keys," for Making and Polishing the Edges of Boot and Shoe Soles;* George C. Todd, Lynn, Massachusetts.

Claim.—"A turned or circular edge-key."

129. For an *Improved Gas Cock and Swinging Joint;* Charles F. Thieme, Philadelphia, Pennsylvania.

Claim.—"Making a swing joint for gas brackets, the same consisting of the tubular plug and its cap, with the leather washer and spring, or their equivalents, in combination with the barrel, so as to produce a gas-tight swing joint without the usual boring and grinding heretofore required. Also, the combination of the key with the lower end of the plug, when the same is used as a 'gas cock,' so as to dispense with a distinct barrel heretofore required for a cock."

130. For an *Improvement in the Construction of Tubular Condensers and Heaters;* Uel West and Abner Mills, City of New York.

Claim.—"The connexion of the ends of the tubes with the conductors, by squaring the ends of the tubes fitting the squared ends of the tubes of each row, close together, and making tight joints between them, and inserting the whole united row directly between the two parallel sides or portions of the conductor, and securing each tube closely to the said sides or portions."

131. For an *Improved Raking Attachment for Harvesters;* William Whitely, Jr., Springfield, Ohio.

Claim.—"The combination of the balance lever with plate, for operating the rake in its forward motion."

132. For an *Improvement in Adjustable Cut-offs for Steam Engines;* William Wright, Hartford, Connecticut.

Claim.—"The construction and arrangement of the adjustable cut-off, consisting of the cylindrical hubs, disks, and their adjustments. Also, the flap valve checks, constructed and combined with the drop valve."

133. For an *Improved Apparatus for Hoisting Coal;* J. Claude White and Robert Hay, Tuckerville, Pennsylvania.

Claim.—"The bucket, with its inclined base, its doors, and spring latches, in combination with the chute and inclined planes."

134. For an *Improved Finger Bar Arrangement for Harvesters;* James A. Moore and Asahel H. Patch, Louisville, Kentucky.

Claim.—"The combination and arrangement of the folded sheet metal bar with fingers, when the latter are inserted through holes in the front and rounded folded portion of the bar, and griped and pinched between and by the lips of the bar in the rear, and secured therein."

135. For an *Improvement in Hand Corn Planters;* Thomas A. Chandler, Rockford, Illinois, Assignor to self and Harlow Herrick, La Grange, Ohio.

Claim.—"The slides, diggers, and rod. Also, the jaws, cut-off, and arm."

136. For an *Improvement in Sewing Machines;* William C. Watson, Assignor to self, George H Wooster, and Morris Knight, City of New York.

Claim.—"The revolving and reciprocating looping hook. Also, the inclined and grooved brace plate, so placed beneath the cloth as to deflect the lower end of the needle to one side of its path, whereby its vibrations are prevented, and it is secured from breakage by the lateral pulls."

ADDITIONAL IMPROVEMENTS.

1. For an *Improvement in Rotary Brick Machines;* George Crangle, Philadelphia, Pa.; patented, June 3, 1856; additional patent, September 9, 1856; 2d additional patent, Nov. 25, 1856.

Claim.—"The application of the cut-off slides, so as to slide up and down in contact with the plungers, respectively, and so as to produce in combination with the lower guide piece, the alternately open and close chambers beneath the plungers."

2. For an *Improvement in Harvesting Machines;* George Esterly, Heart Prairie, Wis.; patented, October 22, 1844; additional patent, Nov. 25, 1856.

Claim.—"The method of constructing the arm of the axle, in combination with the metallic box, and the socket, and yoke, whereby the adjusting apparatus is placed beneath the body of the carriage."

RE-ISSUES FOR NOVEMBER, 1856.

1. For an *Improvement in the Machine for Cutting Shoe Pegs;* Stephen K. Baldwin, Gilford, New Hampshire; patented July 16, 1842; extended; re-issued November 4, 1856.

Claim.—"The combination of the vibrating knife, or its equivalent, with the fluted roller."

2. For an *Improvement in Sewing Machines;* Elmer Townsend, Assignee of Alfred Swingle, Boston, Mass.; patented July 22, 1856; re-issued Nov. 4, 1856.

Claim.—"The employment of a hook in connexion with the looping needle, and arranging said hook so that it shall pass into the cloth or material from the same side of it on which the looping needle work is situated. Also, the new or improved method of arranging the feed motion or mechanism, the feed wheel thereof being disposed horizontally, and its teeth made to engage with those of the rack situated on the vertical side of the clamp."

3. For an *Improvement in Nut Machines;* Robert Griffiths, Philadelphia, Penna.; patented October 30, 1855; re-issued Nov. 25, 1856.

Claim.—"A combination of tables, boxes, and punches, or any equivalent thereto."

DESIGNS.

1. For *Stoves;* James J. Dulley, Assignor to Fuller, Warren & Morrison, Troy, N. Y.; November 4, 1856.

Claim.—"The ornamental design and configuration of the plates or castings for Franklin stoves."

2. For *Parlor Stoves;* Elisha Smith, Albany, New York; Nov. 11, 1856.

Claim.—"The combination and arrangement of ornamental figures and forms, for the plates of a parlor stove."

3. For *Kitchen Stoves;* S. W. Gibbs, Albany, Assignor to Thomas H. Wood, Henry S. Hubbard, and John E. Roberts, Utica, N. Y.; Nov. 25, 1856.

Claim.—"The external ornament and configuration of kitchen stoves."

DECEMBER 2.

1. For an *Improvement in Mop-heads;* Frederic Allen, Worcester, Mass.

Claim.—"My improved spring clamp mop-head, as made of a bar of spring steel, bent and formed with an eye and a hook at its opposite ends, and having a link applied thereto, so as to operate therewith."

2. For an *Improvement in Feeding Paper to Printing Presses;* Moses S. Beach, Brooklyn, New York.

Claim.—"Seizing the back or tail-end of the sheet, and thus returning it to the types for a second impression."

3. For an *Improvement in Earthen Vessels for Hermetically Sealing Purposes;* Edwin Bennett, Baltimore, Maryland.

Claim.—"Constructing the covers or lids of such vessels, with the beveled or sloping edge, and plane surfaces unglazed, or in the biscuit state, when said lid or cover is used in combination with a vessel, the contiguous surfaces of which are also left unglazed, and in an absorbent state."

4. For an *Improved Wristband Fastener;* John P. Derby, Boston, Mass.

Claim.—"Arranging and combining with a face plate, two parallel cross pieces, one of which, the lower or second cross-piece, being constructed with a movable section. Also, the hollow stem through which the post passes that is connected with the movable section of the cross-piece. Also, the arrangement of the lever, in connexion with the face plate and the movable section of the cross-piece, whereby by turning the face plate the desired motion is given to the cross-piece or wing; the whole making an effective fastener."

5. For an *Improved Mode of Backing Electrotype Plates;* Wm. Filmer and Edward Bookhout, City of New York.

Claim.—"1st, The box or hopper placed in an inclined position, and the plate placed within the box or hopper, the bottom of the box or hopper being provided with ledges. 2d, The spiral springs, interposed between the shell and plate."

6. For an *Improvement in Nut Machines;* Robert Griffiths, Philadelphia, Penna.

Claim.—"1st, The manner of securing the punching and cutting bars between the sliding plates. 2d, The combining of the punching and cutting bars with the strippers, the said strippers being whole or divided."

7. For an *Improvement in Ovens;* John P. Hayes, Philadelphia, Pennsylvania.

Claim.—"1st, Making an oblong opening through the plate, which is fixed to the back of each of the ovens. 2d, The arrangement of the soot-catching trough at the back of each of the said ovens."

8. For an *Improved Method of Clamping Cutters in Cutter Heads for Planing Machines;* Jonathan P. Grosvenor, Lowell, Massachusetts.

Claim.—"Connecting the collars with each other or with the core blocks, by means of tongues and grooves."

9. For an *Improved Raking Apparatus for Harvesters;* Stephen R. Hunter, Cortlandt, New York.

Claim.—"The bar, attached or hinged to the arms on the platform, and operated by the spring chain ball, which is fitted in the box, and the plate wheel, when the above parts are arranged to operate in combination with rotary cutters and endless apron."

10. For an *Improved Rock Drilling Machine;* Martin and John P. Gore, St. Louis, Missouri.

Claim.—"The combination of the rock shaft and its arms, with the pawls, ratchets, and the collar on the drill shaft, for effecting the feed and turning of the drill by the upward movement of its shaft."

11. For an *Improvement in Railroad Chairs;* James H. Morley, St. Louis, Mo.

Claim.—"Fishing the joint of railroad bars with a divided chair, to ease the grip of the chair to the rail on the bottom flanch of the rails, when so constructed that the divided bed of the chair shall not come into contact with or impinge upon each other, so as to bear any part of the strain of a weight upon the rails, but leave the upper jaws free to bite with the whole strain of the bolts, whereby they are made to gripe the rail joints more firmly as the cars move over them, without the necessity of being supported upon ties or bearers as heretofore."

12. For an *Improvement in Pentagraphs;* Henry Neumeyer, Macungie, Penna.

Claim.—"The upper sliding frame, in combination with the under stationary frame and casing, and the traversing cog-racks and uprights, the slotted traversing bed plate, with the traversing drawing board or tablet; the compound cog and geared cone pulleys, the compound or double and adjustable rack devices. Also, the grooved sliding rack bar of the traversing rack with its devices, when combined with their pinions and cone pulleys, and the traveling carriage."

13. For an *Improvement in Drying Cylinders for Fibrous Manufactures;* Horace W. Peaslee, Malden Ridge, New York.

Claim.—"The employment of a spiral tubular heater upon a non-conducting cylinder, in combination with an exterior metallic casing."

14. For an *Improvement in the Baby Walker and Jumper;* E. Y. Robbins, Cincinnati, Ohio.

Claim.—"The arrangement of the upward extension of the broad based castor supported frame of the apparatus, around and over the head of the child placed therein, for the purpose of preventing his head from coming in contact with articles of furniture as he moves himself over the floor, and forming a support for the jumper (or child-sustaining canvass-covered hook), and also serving the purpose of suspending toys above the head of the child, and within his reach, to amuse him, and at the same time cause him to judiciously exercise his arms and chest."

15. For an *Improvement in Expanding Tap;* Harley Stone, Uxbridge, and Mason D. Cole, Blackstone, Massachusetts.

Claim.—"The arrangement of the cam piece, the nut and screw, and their connexion with the cutters and case."

16. For an *Improved Ice Saw;* Stephen Scotton, Richmond, Indiana.

Claim.—"1st. The saw, operated or rotated, and placed in the swinging frame, which is rendered adjustable by means of the rack, pinion, and notched wheel. 2d, Moving the platform, and feeding the saw to its work by means of the wheels on the driving shaft, the pinion and screw on the shaft, and the toothed wheel on the axle. 3d, Moving the platform laterally when necessary, by means of the wheel on the shaft, and the wheel on the plate."

17. For an *Improved Axle Box;* William H. Saunders, Hastings, New York.

Claim.—"A lining of a thin tube of condensed and hardened ductile metal or composition, introduced and secured within the box, and presenting a hard polished surface to the axle itself."

18. For an *Improvement in Syphon a Clapit;* Henry M. Walker, Watertown, Conn.

Claim.—The application of a device for the simultaneous opening and closing of the orifices at each end of a syphon."

19. For an *Improvement in Converting Rotary into Reciprocating Motion;* Albin Warth, City of New York.

Claim.—"The intermittent semi-rotating head, or its equivalent, carrying in eccentric relationship to the bearing of said head, a driving pinion for gear with the endless rack, and driven by or operating through suitable gear, a pinion arranged with separate action concentric to said head, the latter being combined with sliding stops, or their equivalents."

20. For an *Improvement in Self-Acting Rakes for Harvesting Machines;* Jesse Whitehead, Manchester, Virginia.

Claim.—"The combination of the rakes and rod, when said parts are made to operate together and independently of each other. Also, in combination with the rakes and rod, the permanent cam and yielding cam, which causes said rakes to advance in one line and return in another line. Also, in combination with the rake head, the rod having its support alternately in and for the purpose of preventing said rake head from binding on its ways. Also, giving the rake a movement varying to the size of each and every gavel."

21. For an *Improved Method of Applying Steam to, and of Cutting Scarfs from Wood;* Job White, Belfast, Maine.

Claim.—"1st, The arrangement of the cams and beam, in combination with the feeding gear, by which the perpendicular and rotary motion of the log is made immediately after the cutters have passed through, giving exact feed to continue a circular kerf around the diminishing surface of the log, making a board of uniform thickness. 2d, The mode and arrangement by which I apply steam or heat to a log in the process of being sawed, by which I am able to apply to the surface of the log immediately before the cutters, and at the particular time and place required for the work designed. The same result may be obtained by a cast iron hollow form, by which you may apply either steam or heat to the surface of the log."

22. For an *Improvement in Wrenches;* Orin O. Witherell, City of New York.

Claim.—"Attaching the fixed jaw of the wrench to a handle, which has its extremity made eccentric by a fulcrum pin, and arranging the movable jaw relatively to said end of the handle and to the fixed jaw."

23. For an *Improvement in Railroad Car Seats and Couches;* Theodore T. Woodruff, Alton, Illinois.

Claim.—"The combination of the movable and fixed frames on one side of each compartment, with the movable and fixed frames on the opposite side thereof, to form each of two depressed couches when unfolded and connected, and which may be converted into two opposite seats when the two movable seats are thrown up and over the permanent frames. Also, combining each of the hinged folding backs on one side of each compartment, with each of the corresponding hinged backs on the opposite side of the same compartment, by means of the folding or connecting frames, or equivalent therefor, whereby the same may be used as backs for the seats or as couches. Also, forming an elevated couch above the windows by the combination of the two sets of hinged frames, so that when not required to be used as a couch, the two sets of frames may be folded up out of the way."

24. For an *Improvement in Railroad Car Seats and Couches;* Theodore T. Woodruff, Alton, Illinois.

Claim.—"In combination with the movable frame and the fixed frame, the employment of the movable seats at the ends of the several divisions, to give the required number of seats when the couches are not used for the purpose of reclining. Also, converting the back of the side seats into an elevated couch, by connecting the upper or back edge of said back to the side of the car, or to the partitions, by hinged joints or other equivalent means, and holding it up in the required elevated position by means of catches, or other equivalent means, in combination with the movable frame and fixed frame, or any equivalent therefor. Also, the manner of connecting the upper or fourth couch with the car, so that it may be let down to be used as a couch, or thrown up to the roof of the car when not required to be used. Also, in combination with the said upper or fourth couch, the hinged or suspended step, for the double purpose of a step to give access to the said upper couch when used as such, and as a means of securing said couch when thrown up out of the way."

25. For an *Improvement in Vault Covers;* Thomas Floyd, Assignor to self and George H. Merkin, Chambersburgh, Pennsylvania.

Claim.—"The guides working in grooves, in combination with cross-bar, spring, and rod, for the purpose of elevating the cover. Also, guides, in combination with catches or bolts and springs, for fastening the cover down."

26. For an *Improvement in Engines for Grinding Paper Stock;* Vespasian O. Balcom, Bedford, Mass., and Charles H. Hill, Billerica, Mass.

Claim.—"The revolving pulp tub, or its mechanical equivalent, in combination with the grooved grinding roller, revolved therein at a greater or different speed than this tub. Also, the combination of the revolving pulp tub, and friction or evening roller."

27. For an *Improvement in the Bramah Planing Wheel;* Edwin Jones, Greenfield, Massachusetts.

Claim.—"Providing the planing wheel with knives for edging or jointing the articles when arranged as a single instrument."

28. For an *Improvement in Covering Thread with Wool;* Andrew L. Fuller, Clinton, Massachusetts.

Claim.—"The mode of placing the core in the sliver, and covering it by the combined action of the comb and condenser, so as to produce the sliver, and this I claim whether a twist be given to the sliver or not."

29 For an *Improvement in Steering Apparatus for Ships;* David W. Smith, Boston, Massachusetts.

Claim.—"The arrangement of the guard rack and the pinion on the tiller, with the main rack and the pinion of the hand wheel shaft."

30. For an *Improvement in Casting Metallic Tubes;* James Smith, Jr., Norton, Massachusetts.

Claim.—"The method of making the metallic mould core, viz: of removable separate sections or staves, and a narrow trapezoidal or wedge-shaped spring or stave, the whole being arranged and held together by rings and plugs, or their mechanical equivalents."

31. For an *Improved Hand Stamp;* Nathan Ames, Saugus, Mass., Assignor to Boston Hand Stamp Company.

Claim.—"In combination with the other parts of any stamp to be held in the hand the leg or wire so constructed as to strike the article to be printed in advance of the type block, and thereby cause the inking roller to pass over the printing surface, while the latter is descending. I do not confine myself to any particular manner, as there may be many in which the leg may be made to communicate motion to the inking roller, but I claim this leg both independently of the inking apparatus and the other parts of the stamp."

MECHANICS, PHYSICS, AND CHEMISTRY.

*On Water Metres.**

Sir,—Your August number contains an article describing Mr. Kennedy's Water Metre, and embodying a report, by Mr. G. W. Stevenson, of Halifax, on the comparative results obtained by him in testing Taylor's, Siemens', and Kennedy's metres.

Being interested in one of the metres referred to, which bears my name, I shall refrain from criticism of Kennedy's metre ; but I feel called upon to trouble you with a few remarks regarding Mr. Stevenson's experiments, with a view to caution your readers and the public against hasty conclusions, and to elicit truth by inviting to farther and more careful inquiry.

In order to avoid misapprehension, I beg to state distinctly that I do not doubt Mr. Stevenson's scrupularity in stating the results of his experiments such as he found them ; but what I object to is, his mode of conducting the experiments, which affords no security against error, which leads to erroneous conclusions respecting the capabilities of each metre, and also leaves untouched the two chief desiderata of a water metre,—those, namely, of durability and facility of application.

1. *As to the accuracy of measurement.*

Mr. Stevenson filled a gallon measure one hundred times through each metre, and found that in the first experiment Siemens' metre went 5 per cent. too fast ; in the second, one per cent. too slow, and in the third correctly; whereas Kennedy's metre was always correct within 1 per cent. It would appear from this, that Siemens' metre varied as much as 6 per cent. between two consecutive experiments, which I believe, from *long experience*, to be *quite impossible.* But it is not difficult to account for an error of a few per cent. by Mr. Stevenson's primitive mode of measuring the water as it is passed through the metre, and in reading so small a quantity as 100 gallons upon a dial indicating 1000 gallons by one single turn. I maintain that the proper way of trying the accuracy of a metre is, to pass through it a quantity not less than 1000 gallons, and to run the same into a cistern holding that quantity between marks ascertained by exact calculation, or rather by weight.

2. *As to relative quantity delivered.*

Mr. Stevenson has taken for his standard of comparison the diameter of the unions attached to each metre, whereas the proper standard would have been similar quantities stated to be delivered according to the published prospectuses.

Experience has induced Messrs. Guest and Chrimes, the manufacturers of Siemens' metres, to limit the power of delivery to what is practically required, by restricting the passage through the metre. Such restriction will not impede the flow of water through a long range of pipes (it is well known to engineers practically acquainted with water works, that a sluice in a range of pipes may be more than half shut without impeding the flow of water, the reason being that the vis inertia the water acquires in passing the restriction is spent again in the succeeding pipe in urging the water column forward), but is intended to diminish the delivery in cases where the metre is placed at the extremity of a pipe. High pressure metres are generally applied below ground at the entrance of a branch pipe into an establishment; and in order to test the real capabilities of such a metre, it ought to be placed as nearly as possible under these normal conditions, which was not the case in Mr. Stevenson's experiments. But adopting for the sake of argument, Mr. Stevenson's results, he is evidently mistaken when he says that "the price also (of Kennedy's metre) is really less *pro rata* than that asked for either Taylor's or Siemens'. Taylor's being £5 per inch, Siemens' a little more, and Kennedy's about eight guineas." The report goes on: "The capacity for supply, however, ought to regulate the price, &c." Now, if Mr. Stevenson would refer to Messrs. Guest and Chrimes' list of prices, he would find that their metre with 1½ inch inlet, will deliver just twice the quantity of their 1 inch, and consequently the same quantity as Mr. Kennedy's with 1 inch inlet. The price of Siemens' metre with 1½ inch inlet is, however, only £3 6s., or slightly less than Kennedy's of the same power of delivery, under the unfavorable circumstances of the experiment. No account is taken of the cost of transport and erection, which in the case of Kennedy's metre exceeds considerably that of Siemens' metre, owing to its far greater bulk and weight.

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* From the Lond. Civ. Eng. and Arch. Journ., Sept. 1856.

3. *As to relative loss of pressure sustained by the passage of water through the metre.*

In Kennedy's metre the water has to move a piston and to pass through several short bends, whereas in Siemens' it has always a free passage through curvilinear channels, that represent, together with the inlet, two bends. It is, therefore, not well possible that Siemens' metre should impede the water more than Kennedy's, provided the quantity of water delivered does not exceed the limits assigned to it.

Having now referred to the three points of Mr. Stevenson's investigation, I have to suggest a fourth point, which far exceeds the others in importance, namely:

4. *As to durability.*

It is a comparatively easy problem to produce a metre that shall give satisfactory results in a laboratory experiment. Indeed the first metre the writer ever made, in 1851, left little to be desired in this respect, and was highly approved by a committee of the Manchester Corporation Waterworks. All the difficulty, however, was to come, and consisted in producing an instrument from which more is required than ordinary mechanism will stand. A high pressure water metre is generally placed below ground, and is required to work for several years without needing any attention whatever. Unlike the gas metre, it has to work under pressure ranging from a few inches to 300 feet of water column; it has to resist great concussions in the water, and to be unaffected by impurities—such as sand, shells, and vegetable matter—in the water, nor by its calcareous deposits; combining with this extreme delicacy of action. It remains for Mr. Kennedy to prove that his piston, tumbler, and valve possess the quality of resisting permanently these agencies; but in order to judge of the relative merits of several metres, I should suggest to put the same in a trying situation, both as regards pressure and impurities (at the end of a low-level main for instance), to lock them up for six or twelve months, and then examine them as regards their accuracy of measurement and general state of conservation.

In conclusion, I may be allowed to state an interesting fact regarding Siemens' metres, namely, their accuracy (within 3 per cent.) and their durability being guarantied by the manufacturers; all defective metres are returned to them, and the number so returned, during the last 14 months, has been 33 out of nearly 2000 metres in operation. The increasing demand for them does not bear out Mr. Kennedy's statement, that no satisfactory metre existed before his own was proposed.

London, 25th August, 1856. W. SIEMENS.

On Nature Printing.[*] HENRY BRADBURY, Esq., M. R. I.

The art of nature printing is a method of producing impressions of plants and other natural objects, in a manner so truthful that only a close inspection reveals the fact of their being copies. So distinctly sensible to the touch are the impressions, that it is difficult to persuade those unacquainted with the manipulation, that they are the production of the printing press. The process, in its application to the reproduction of botanical subjects, represents the size, form, and color of the plant, and all its most minute details, even to the smallest fibre of the roots.

The distinguishing feature of the process, compared with other modes of producing engraved surfaces for printing purposes, consists, firstly, in impressing natural objects—such as plants, mosses, seaweeds, feathers, and embroideries—into plates of metal, causing as it were the objects to engrave themselves by pressure; and secondly, in being able to take such casts or copies of the impressed plates as can be printed from at the ordinary copper-plate press.

This secures, on the one hand, a perfect representation of the characteristic outline of the plant, as well as that of some of the other external marks by which a plant is known, and even in some measure its structure, as for instance in the venation of ferns, and the leaves of flowering plants; and on the other, affords the means of multiplying copies in a quick and easy manner, at a trifling expense compared to the result obtained—and to an unlimited extent.

The great defect of all pictorial representations of botanical figures has consisted in the inability of art to represent faithfully those minute peculiarities by which natural objects are often best distinguished. Nature printing has therefore come to the aid of this branch of science in particular, whilst its future development promises facilities for copying other

[*] From the Royal Institution of Great Britain.

objects of nature, the reproduction of which is not within the province of human hand to execute; and even were it possible, it would involve an amount of labor scarcely adequate to the results obtained.

Although considered for some years past in various parts of Europe as a new art, the idea is by no means so recent as is supposed: much less is there ground for the Austrians to assert their exclusive right to the priority of the invention, merely on account of the first application of the process in its fullest extent in the Imperial Printing-Office at Vienna.

Councillor Auer* has not only done this, but he has claimed for nature printing a position to which it has no right: he has compared it to the invention of writing and the art of printing; moreover, he has placed it on an equality with the Galvanoplastics of Jacobi and Spencer, and the Daguerreotypes of Daguerre. Valuable as are the results of nature printing, it still has its defects; it has its limits, and its applications are limited, and care will be required to confine it within the bounds of its capabilities.

That an establishment, so renowned for its productions as that at Vienna, unlimited in its command of the resources of science and mechanism, should have been the first to bring any invention connected with printing to a practical state of perfection, is not matter to create surprise; but that it should, in the most unqualified manner, in the name and on authority of its chief director, claim all the honor of the discovery, is a point that is open to question, and in point of fact is questioned by several private individuals, who, for want of those unlimited resources and opportunities which only government establishments are able to command, were unable to crown their experiments with practical results.

Nature printing is nothing more than an application of facts worked out by various persons, in different countries, under very different circumstances, and at very different periods; and by tracing out its history, and detailing the earlier experiments connected with it, Mr. Bradbury hoped to show that he did not put forward personally any claim either to its origin or to its first application; but, that he spoke as one who, having perceived its value, was desirous to render it an available auxiliary to the printing press.

Nature herself, in her mysterious operations, seems to have given the first hint upon the subject: witness the impressions of Ferns so beautifully and accurately to be seen in the coal-formations.

Experiments to print direct from nature were made as far back as about two hundred and fifty years—it is certain that the present success of the art is mainly attributable to the general advance of science, and the perfection to which it has been brought in particular instances.

On account of the great expense attending the production of woodcuts of plants in early times, many naturalists suggested the possibility of making direct use of nature herself as a copyist. In the *Book of Art*, of Alexis Pedemontanus, (printed in the year 1572,) and translated into German by Wecker, may be found the *first* recorded hint as to taking impressions of plants.

At a later period in the *Journal des Voyages*, by M. de Moncoys, in 1650, it is mentioned that one Welkenstein, a Dane, gave instruction in making impressions of plants.

* *Vide* Denkschriften der Kais. Akademie, Wien; Math.-Nat. Classe. Band V., p. 107, (illustrated by many plates)

The process adopted to produce impressions of plants at this period, consisted in laying out flat and drying* the plants. By holding them over the smoke of a candle, or an oil lamp, they became blackened in an equal manner all over; and by being placed between two soft leaves of paper, and by being rubbed down with a smoothing-bone, the soot was imparted to the paper, and the impression of the veins and fibres was so transferred.

Linnæus, in his *Philosophia Botanica*, relates that in America, in 1707, one Hessel made impressions of plants; and between 1728 and 1757, Professor Kniphof, at Erfurt, who refers to the experiments of Hessel, in conjunction with the bookseller Fünke, established a printing-office for the purpose. He produced a work entitled *Herbarium Vivum* (a copy of which was laid before the Members). The range and extent of his work, twelve folio volumes, and containing 1200 plates, corroborates the curious fact of a printing-office being required. These impressions were obtained in a manner very similar, but with the substitution of printer's ink for lamp-black, and flat pressure for the smoothing-bone. A new feature at this time was introduced—that of coloring the impressions by hand, according to Nature—a proceeding which though certainly contributing to the beauty and fidelity of the effect, yet had the disadvantage of frequently rendering indistinct, and even sometimes totally obliterating, the tender structure and finer veins and fibres. Many persons at the time objected to the indistinctness of such representations and the absence of the parts of fructification; but it was the decided opinion of Linnæus, that to obtain a fac-simile of the difference of species was sufficient.

Seligmann, an engraver at Nuremburg, in 1748, published in folio plates figures of several leaves he had reduced to skeletons. As he thought it impossible to make drawings sufficiently correct, he took impressions from the leaves in red ink, but no mention is made of the means he adopted. Of the greater part he gave two figures, one of the upper and another of the lower side.

Even at this early period the idea must have excited much attention; for it is recorded that Seligmann had announced his intention to give figures of natural objects as magnified by a solar microscope, and that two were to have been published every month. But he died soon after, and a law suit prevented the prosecution of his work. Two black and twenty-nine red plates of leaves had been already completed, and were published with eight pages of text, in which his coadjutor, Crew, speaks of the physiology of plants, and Seligmann of the preparation of leaf skeletons. The leaves represented on the plates were those of the orange, lemon, shaddock, &c.

In the year 1763 the process is again referred to in the *Gazette Salutaire*, in a short article upon a *Recette pour copier toutes sortes de plantes sur papier.*

About from twenty-five to thirty years later, Hoppe edited his *Ectypa Plantarum Ratisbonensium*, and also his *Ectypa Plantarum Selectarum*, the illustrations in which were produced in a manner similar to that employed by Kniphof. These impressions were found also to be durable, but still were defective. The production of impressions could only take place very slowly, as the blacking of the plants with the printer's ball required much time. Rude as the process was, and imperfect the result, it was nevertheless found that the figures thus produced were far more characteristic than any which artists could produce. The fault of the method consisted in its limited application and in its incompleteness; since the fragile nature of the prepared plant, if ever so carefully treated, would admit of but very few copies being taken, and where any great number would have been required, many plants must have been prepared, a circumstance which was in itself a great obstacle.

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* Although the plants were dried in every case, Mr. Bradbury stated, that it was by no means absolutely necessary, as he proved by the simple experiment of applying lampblack or printer's ink to a fresh leaf, and producing a successful impression.

In the year 1809 mention is made in Pritzell's "Thesarus" of a *New Method of taking Natural Impressions of Plants;* and lastly, in reference to the earlier history of the subject, the attention of scientific men was called to an article, in a work published by Grazer, in 1814, on a *New Impression of Plants.*

Twenty years afterwards, the subject had undergone remarkable change, not only in the mode of operation to be pursued, but also in the result produced,—which consisted in fixing an impression of the prepared plant in a plate of metal by pressure.

It appears, on the authority of Professor Thiele, that Peter Kyhl, a Danish goldsmith and engraver, established at Copenhagen, applied himself for a length of time to the ornamentation of articles in silver ware, and the means he adopted were, taking copies of flat objects of nature and art in plates of metal by means of two steel rollers.

Various productions in silver of this process were exposed in the Exhibition of Industry held at Charlottenburgh, in May 1833. In a manuscript, written by this Danish goldsmith, entitled *The Description (with forty-six plates) of the Method to Copy Flat Objects of Nature and Art*, dated 1st May, 1833, is suggested the idea of applying this invention to the advancement of science in general. The plates accompanying this description represented printed copies of leaves, of linen and woven stuffs, of laces, of feathers of birds, scales of fishes, and even of serpent-skins.

The manuscript contains ample and clear instructions to carry out the method, and a few extracts, in his own words, of the leading features will be perhaps interesting. He thus writes:—

"As a correct copy of the productions of Nature and Art must be of great importance, I am delighted to have the honor of submitting to the friends of Art and Science a method I have discovered, by which copies of most objects can be taken, impressed into metal plates, and which enables the naturalist and botanist to get representations of leaves, feathers, scales, &c., in a quick and easy way; and these copies will give all the natural lineaments, with their most raised or sunken veins and fibres; moreover, the artist can, by means of this invention, make use of Nature's real peculiarities for ornamental compositions and productions; and the merchant can get patterns of delicately woven or figured stuffs, laces, tickens, ribbon, linen, and so forth.

"To fix an impression into a plate of copper, zinc, tin, or lead, properly prepared for the purpose, a rolling machine with two polished cylinders of steel is required; if a *leaf*, quite dried and prepared, is placed between a polished steel plate half an inch thick and a thoroughly heated lead plate with a fine surface, and these two plates with the leaf between be run speedily between the cylinders, the leaf will by the pressure yield its form on the softer lead plate, precisely as it is shaped, with all its natural raised and sunken parts.

"I tried many ways to fix the leaf on the plate by some glutinous matter, but it filled the delicate pores and deep parts so much as to render the copies very indistinct.*

"The printing itself of the leaf into the metal requires much precaution, especially with respect to placing the cylinders exactly parallel, and at the same time at a proper distance, and to have the plate to be stamped carefully burnished and polished; besides, the utmost care must be used, as particles of dust or dirt would be printed together with the object itself. Moreover, care must be taken, that the rolling of the plates is managed well, so as to run parallel, without deviating from their first direction.

"Leaves that are to be printed must first be spread upon a clean sheet of paper and placed upon a warm oven; a second sheet put over them is to be strewn with sand, and the whole left to dry under a weight. This done the leaves are taken out with due precaution, and placed for a quarter of an hour into water. They are dried again in the same way, and this manipulation is repeated four or five times. By this means I always found that the leaves gained in tenacity and firmness, that they lost all their moisture, and became more fit to be stamped. Objects, such as laces, weavings, figured ribbons, and such like, can be printed without any preparation, provided they be spread flat between the plates.

"The season being very unfavorable for gathering good strong leaves, I had to overcome many difficulties, so that the copies are not so good as they might have been—for I have observed that leaves obtained from green-houses do not yield such distinct prints as those that grow in the open air, when properly developed."†

It would appear from the practical hints here given, that Peter Kyhl was no novice at the process. He distinctly points out what he conceives to be its value, by the subjects that he tried to copy; and he enters into detail on the precautions to be observed in the operation of impressing metal plates so as to insure successful impressions. His manuscript explains that he had experimented with copper, zinc, tin, and lead plates. Still there existed obstacles which prevented him from making a practical application of his invention. In the case of zinc, tin, and copper, the plant, from the extreme hardness of the metals, was too much distorted and crushed; while in lead, though the impression was as perfect as could be, there was no means of printing many copies, as it was not possible after the application of printer's ink to retain the polished surface that had been imparted to the lead plate, or to cleanse it so thoroughly as to allow the printer to make impressions free from dirty stains. This was a serious obstacle, which was not compensated for even by the peculiar rich surface of the parts that were impressed, attributable to the lead being more granular than copper, and which is so favorable to adding density or body of color, without obliterating the tender veins and fibres. Peter Kyhl died in the same year that he made known his invention. At his death, his manuscripts and drawings were deposited in the archives of the Imperial Academy at Copenhagen, where they remained for upwards of twenty years: and it is a remarkable fact, that, shortly after his death, was discovered the only thing wanting to render the process, as explained by him, at once available for practical purposes. Had Kyhl lived to prosecute his experiments, he might have accomplished more than he did without requiring the aid of other means.* It was he who discovered how to take impressions in metal plates, by using steel rollers.

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* Mr. Bradbury stated that he had himself tried this method without success.

† This allusion to the want of tenacity and firmness in young, and especially in green-house plants, is quite consistent with the experiment made at the present time. Mr. Bradbury stated, that to obtain an impression at all, upon a plate of metal, of a plant, it was indispensable that the plant should be thoroughly dried and free from sap; otherwise the plant would spread in all directions, without leaving any visible indentation. Objects such as lace, and figured fabrics, can be impressed without any preparation, provided they be spread flat between the plates.

This is the first element in the process of Nature Printing. It fell to Dr. Ferguson Branson, of Sheffield, to suggest the second, and the most important.

(To be Continued.)

For the Journal of the Franklin Institute.

Particulars of the R. M. Steamer Arabia, (*Cunard Line.*)

The following particulars of this steamer, are given in addition to those that have been before published (*vide Journal*, vol. xxv., pp. 122, 137).

Hull.—

Length of keel and fore rake, . .		255 feet.	
Breadth over wheel-house, . .		40 "	8 inches.
" of beam, . . .		66 "	4 "
Depth of hold, . .		27 "	6 "
" over flanching, . .		30 "	10 "
Length of engine room, . .		62 "	6 "
Draft of water (mean), . .		19 "	
Area of midship section at this draft,	606 sq. ft.		
Displacement at "	3900 "		
Horse-power (Admiralty), .	873 "		
Cylinders—103 in. in diameter × 9 feet stroke.			
Air-pump—60½ in. diameter × 4 feet 7 in. stroke.			
Height of water wheel shaft, . .		22 feet	9 inches.
Diameter of water wheel, . .		37 "	6 "
Wheel blades—28 of 10½ feet in length × 3 feet 2 inches.			

Boilers.—Four tubular, with 24 furnaces.

Furnaces—8 feet 4 in. × 3 feet 2½ inches.		
Area of grate surface, . .	642 sq. ft.	
Heating surface, .	16,948 "	
Length of fire rooms, . .		12 feet.

C. H. H.

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* Khyl, as it was, had had his attention directed and had made experiments to overcome this one remaining difficulty. His manuscript also contains many interesing and practical remarks upon other processes than simply Nature Printing.

For the Journal of the Franklin Institute.

Particulars of the Steamer William H. Webb.

Hull built by Wm. H. Webb. Machinery by the Allaire Works, New York. Intended service, New York Harbor and Coast.

HULL.—

Length on deck, from fore part of stem to after part of stern post, above the spar deck,		190 feet.	
Breadth of beam at midship section (molded),		31 "	
Depth of hold,		12 "	
" " to spar deck,		12 "	
Floor timbers at throats, molded, 13 ins., sided, 12, 14 and 15 inches.			
Frames apart at centres—30 and 32 inches.			
" strapped with diagonal and double laid iron straps, $4\frac{1}{2}$ by $\frac{5}{8}$-inch.			
Draft of water at load line,		7 "	6 inches.
" " below pressure and revolutions,		7 "	6 "
Area of immersed midship section at this draft,		194 sq. ft.	
Tonnage, custom house,	670.		
Contents of bunkers in tons of coal,	25.		
Masts and rig—none.			

ENGINES.—Overhead beam—Vertical.

Diameter of cylinders,			44 inches.
Length of stroke,		10 feet.	
Maximum pressure of steam in pounds,	35.		
Cut-off—$\frac{1}{2}$-stroke.			
Maximum revolutions per minute,	22.		

BOILERS—Two—Return flued.

Length of boilers,		30 feet.	
Breadth " front,		10 "	6 inches.
Diameter of round shell,		9 "	
Number of furnaces in each boiler,	2.		
Breadth " "		4 "	7 "
Length of grate bars,		8 "	
Diameter of smoke pipe,		3 "	10 "
Height " "		35 "	
Description of coal,	Anthracite		
Draft,	Natural.		

PADDLE WHEELS.—

Diameter,		30 feet.	
Length of blades,		4 "	7 inches.
Depth "			28 "
Number "	42 halves.		
Dip of wheels,		3 "	9 "

Remarks.—This vessel is built to supply the place of the *Leviathan*, burned off Sandy Hook last Spring. She is admirably designed for the purpose, being modeled for high speed, with independent engines of great power, with great shear of deck forward, and with no other encumbrance upon her deck than wheel and engine houses. She is the exact type of a tug, either as a tow-boat or to relieve stranded vessels, for which duty her great power, and independently acting engines, render her unequalled in any waters.

As a means of comparison by which to estimate her power, the following elements are conclusive. The *Leviathan*, the fastest steamer ever built in any country, had 196 cubic feet of steam cylinder to an immersed section of 176 square feet. This steamer, with a like model, has 211 cubic feet of cylinders, to 194 square feet of like section.

C. H. H.

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*Captain Uchatius's New Process for the Manufacture of Steel.**

For the satisfaction of a number of scientific gentlemen, engineers, and others interested in the subject, an exhibition of the new method of manufacturing steel, the discovery of Capt. Uchatius (Engineer in Chief of the Imperial Arsenal at Vienna), was made on Saturday, October 11th, at Messrs. Rennie & Sons, the Albion Engine Works, Holland street, Blackfriars-road.

Mr. Charles Lentz, the partner of Captain Uchatius, operated on the occasion, assisted by workmen from the factory of Messrs. Turton & Co., at Sheffield. Whilst the process was going on, Mr Lentz read a paper descriptive of the invention. He commenced by explaining that he had labored under many disadvantages in being compelled to contrive substitutes for the regular furnaces and other proper appliances peculiar to steel works, but, nevertheless, an opinion could be there formed of the merits of this important invention, for all the melting operations in cast steel manufacture were necessarily a series of operations on a small scale, the size of a steel crucible limiting the magnitude of the furnaces. He proceeded to state that the method adopted in England, and all over the world, he might say, for making the best descriptions of cast steel heretofore, was to convert Swedish or Russian bar iron, by a lengthy, uncertain, and costly process, first into what is called blister steel, which product was then melted down in crucibles and cast into ingots for the manufacture of the bar steel of commerce. The invention about to be exhibited by him would render this country quite independent of Sweden and Russia for steel iron-making, as he would show the company present that East India pig iron, now very plentiful and cheap here, could be converted into fine steel in as few hours as Swedish and Russian bar iron would take weeks to manipulate; in addition to which, he could assure those present that numerous descriptions of ordinary English pig iron would answer for this process equally well, if he might judge from the limited experiments in English iron, he had performed. Indeed, the results of these experiments were very remarkable, and he expected that nearly all the iron works would soon make steel as regularly as they now made iron. He begged the company to consider the importance of a discovery which would so reduce the cost of steel as to render it available for numerous purposes in engineering, now quite precluded by the price; he did not hesitate to assert that fully two-thirds might be saved in the cost of producing cast steel by using the present instead of the old process. Mr. Lentz then proceeded to explain that the invention of Capt. Uchatius was founded upon the well-known fact that cast iron surrounded by any oxygenized materials, and subjected to a cementing heat for a given time, would yield up a portion of its carbon, which would combine with the oxygen driven off from the surrounding materials, forming carbonic oxide or carbonic acid gas. If this process were interrupted before completion, a partially decarbonized iron would result, the surface of which would have been converted into a pure iron, while the inner parts remained unchanged ; or, in other words, the progress of the decarbonizing action would depend on the amount of metallic surface brought into contact with the oxygen-yielding material with which the iron was surrounded. In order, therefore, to expedite this operation, the pig iron was first reduced to a granulated state, which was accomplished by simply running the molten iron from the cupola (a blast furnace in some cases,) into cold water, agitated by mechanical means. This granulated iron was mixed with a proper proportion of pulverized oxygen-yielding materials of a very cheap description, such as sparry iron ore (spathose ore), and adding, if requisite, a small quantity of manganese, which mixture was put into common crucibles, and subjected to heat in a cast steel blast furnace of ordinary construction. By thus subjecting the granules of iron, in presence of the sparry iron ore, to a melting heat, the surrounding oxides would first effect a partial decarbonization of the granulated iron, which decarbonization would be limited in amount according to the size of the granules operated upon, and by reason of the continued application of heat the iron would melt and separate (with the assistance of the melting residue of sparry iron ore) from the impurities with which it was mixed, and also bring down with it a portion of the iron contained in the sparry iron ore, thereby increasing the yield of cast steel by about 6 per cent. The manipulations of melting and casting were the same as those commonly employed by cast steel manufacturers. The quality of the steel made by this process could be considerably modified. Thus, the finer the pig iron was granulated, the softer would be the steel made therefrom. The softer sorts of welding cast steel might be obtained by an addition of good wrought iron in small pieces, and the harder qualities by adding charcoal in various proportions to the before-mentioned mixture. Thus, continued Mr. Lentz, might crude iron be converted into steel ingots in the incredibly short space of about two hours.

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* From the Lond. Artizan, Nov., 1856.

Mr. Lentz then proceeded to exhibit the preliminary process of granulating, by running a crucible of melted pig iron into a vessel of water, when it was instantaneously converted into shot-like particles. A weight of 24 lbs. of the granulated iron was mixed with 6 lbs. of crushed ore and peroxide of manganese, in the proportion, it was said, of about 4 lbs. of ore and 2 lbs. of peroxide of manganese, to which was added a small quantity of fire-clay, and filled into the crucible in the temporary furnace, and allowed to melt in the usual manner. In the meantime the company proceeded to witness the operation of the hammering down into a bar of an ingot of this new steel, which had been made a few days since, and although the steam-hammer used was not at all adapted for steel, nevertheless, the bar of steel produced from the ingot then hammered was pronounced to be of excellent quality, and tools made by Messrs. Rennie, from a fellow ingot, were tried and found to possess the qualities of fine English cast steel. After two hours and three-quarters had elapsed since the filling—some defect in the blast a little retarding the melting—the contents of the crucible were poured into the iron mould, from which, when opened, an ingot of steel, weighing 25 lbs., being 1 lb. more than the iron used, was exhibited to the company, which bore every external evidence of being perfect in quality. It was to be forwarded to the steel works of Messrs. Spencer & Sons, of Newcastle-on-Tyne, to be properly tilted into bar steel for further tests as to its quality and properties. The simplicity and rapidity of the new process, as well as the quality of the specimens of steel shown, elicited much admiration. The importance of the process in reducing the cost of steel can scarcely be overrated when the innumerable new uses to which it would inevitably be turned in preference to iron are considered—the expense of steel tyres, axles, piston-rods, shafts, and other important working parts of machinery being estimated as not exceeding the price now paid for first-class iron.

*The Conical Bullet-Making Machinery.**

Designed by John Anderson, Esq., Inspector of Machinery to the War Department.

When the Minie rifle was introduced in 1852, the hollow elongated bullet was cast in a metal mould in the usual manner; but from the fact of great accuracy being required, both in the density and dimensions of such projectiles, in order to secure the full advantages of this admirable weapon, it soon became apparent that a more refined mode of making these bullets was essentially requisite; at the same time it must be such a mode as would secure the necessary softness in the metal, so as to enable it to expand within the rifle, the whole success of the arm being dependent on that condition.

In the earlier attempts in this direction, the bullets were first cast in a mould, and then stamped accurately with dies in an ordinary fly-press: this method is still resorted to by those who have not better machinery.

An attempt was made by the late Mr. Lovel to cast lead into rods of the required diameter, then by means of hand shears to cut these rods into pellets of the required weight, and, with the aid of a fly-press and pair of dies, to convert these pellets into bullets; but here two difficulties presented themselves.

First. The weight of the bullet depended on the quantity of lead cut off the rod into the pellet; therefore perfect accuracy in that particular could not be secured.

Second. As the whole of the lead cut off to form the pellet had to go towards the construction of the bullet.

The dies had to be made so as to form the required bullet between them, with a certain fixed quantity of lead, any excess being spread over between the dies, and which would have to be pared off by hand; while, on the other hand, any deficiency would allow the dies to come into hard contact, thus destroying their fine edges, and rendering them useless.

In this condition, and with these objections, the shears and fly-press were put into the hands of Mr. Anderson, in order to have these difficulties overcome, and the result of his perseverance is in the machine before us.

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* From the Lond. Artizan, Nov., 1856.

In order to enable the machine to be made self-acting, the lead is squirted into a long rod of about 5 cwt., by means of hydraulic pressure, and which is then wound upon a reel placed above the machine, and from which it unwinds as the manufacture proceeds.

On looking at the plan, it will be seen that there are four separate sets of dies, each of which are complete with lead-reel, cutting-off shears, and die apparatus; and otherwise are exactly alike. It will also be seen that the machine is so constructed that one set of driving apparatus, eccentric motion, and cam shaft, are made to serve for two sets of dies, a bullet being formed at each movement.

The process consists of three operations:—First, cutting off the lead from the rod and delivering it to the dies; second, the forming of the bullet; and third, the mode of stripping off the ring of superfluous lead from the bullet, as it is ejected from the die.

First. The lead rod is unwound from the reel by means of a pair of rollers, which are worked by a ratchet wheel from the reciprocating motion of the machine. These rollers, after a little working, become so loaded on their exterior surface as to prevent any slip, the amount of motion given to the rollers being dependent on the adjustment of the pawl stud in the rocking lever.

The end of the lead rod is pushed through a hole in the lever, this hole being bushed with steel, so as to act as a shear; when the proper quantity is pushed through the hole, the extremity is seized by the pair of nippers, and immediately the end of the lever is raised by a cam, thus separating the piece in the nippers from the rod. So soon as the nippers have the pellet of lead in its own iron fingers, it opens just sufficient to allow it to drop, the lower end of the nippers being so constructed as to hold the lead when it is exactly in front of the dies; at that instant the punch, or movable die, comes towards the fixed die, and pushes it in a very minute distance sufficient to prevent it from falling; then the nippers open at the bottom and close at the top for the next bullet; the several motions of the cutting lever and nippers being worked by cams of the required shape on the horizontal shaft.

To prevent any irregularity in the length of lead pushed through the nippers, a cross-bar, or stop, is placed behind them, the rollers are set to give rather more than the required quantity, thus butting hard each time; the metal being soft yields, and thus prevents accident to the apparatus.

Second. The dies are by far the most important part, and require to be made with extreme accuracy.

The fixed die is made the shape and size of the bullet, but having a movable bottom by means of which the bullet is ejected. The die holder is made adjustable with set screws.

The punch, or movable die, is fixed in the end of the reciprocating spindle; this forms the hollow interior and rear end of the bullet; the two dies, if brought into contact, thus forming a complete bullet.

In order to allow the lead to fill up into the extremities of the bullet, it is necessary to have not only the fixed die ventilated, but also the punch. The former has a hole through the ejecting spindle about the size of a hair; this allows the air to pass out, but intercepts the lead.

If the two dies that form the bullet were allowed to meet, in order to complete the operation, there would be the constant liability of their coming together without the pressure of lead, which would cause them to destroy each other; for, however rigid the machine might be made, there would be a certain amount of elasticity, which would insure fracture of the dies, to prevent which is the third part of the apparatus.

The two dies are not allowed to meet by about the $\frac{1}{50}$ of an inch, the superfluous lead being formed into a ring or frill around the bullets at the point of junction. When the movable die or punch has performed its part of the operation it retires, and immediately a third die, in the form of a plate of steel, with a hole in it the exact size of the bullet, rises up in front of the fixed die, and through this hole the bullet is ejected, but the ring or frill is stripped off over the bullet towards the point, thus delivering it complete and ready for the cartridge; and by taking care this hole is of the proper size, it forms a gauge to rectify any wear which may take place in the fixed die.

The motions for ejecting the bullet and for working the steel plate are obtained from cams on the cam shaft.

Each set of dies can turn out about 32 bullets per minute; the produce of a machine being about 74,000 per day. There are four of these machines at work in the Royal Arsenal, yielding, when in full operation, about a quarter of a million daily; or, if working night as well as day, as was the case during the war, then the double of that quantity.

To have made this latter quantity by the former system, would have cost, in wages alone, the sum of £62 10s.; but, by the introduction of this machine, it is less than the fiftieth part of that amount; while, as regards accuracy, there can be no comparison.

Safety Lucifer Matches.*

The safety lucifer match is the invention of Lundstrom, a Swede, who has a large match manufactory at Jonkoping, in Sweden, where some hundred workmen are employed, and eight or more millions of matches are produced daily. They are about to be introduced into this country by the firm of Bryant & May, London, who are the largest importers of German and Swedish lucifers in the kingdom. A patent has been taken out in their name for the sale in England of the Swedish match. Its peculiarity consists in the division of the combustible ingredients of the lucifer between the match and the friction paper. In the ordinary lucifer, the phosphorus, sulphur, and chlorate of potash or nitre, are all together on the match, which ignites when rubbed against any rough surface. In the Swedish matches these materials are so divided that the phosphorus (which is employed solely in the amorphous state,) is placed on the sand-paper, whilst the sulphur, and a minimum amount of chlorate or nitrate of potash, is placed on the match. In virtue of this arrangement, it is only when the phosphorized sand-paper and the sulphurized match come in contact with each other that the ignition occurs. Neither match nor sand-paper, singly, takes fire by moderate friction against a rough surface. The matches are thus much less liable to cause accident by casual ignition than the ordinary ones ; and the recent edict by the Spanish Government against the employment of lucifers by the peasantry of the forest districts in dry weather (which will certainly be evaded) would be needless, if the Swedish matches were in general use. If they fully answer the announcements of the inventor, and it is due to him to acknowledge that they excited great interest at the Exhibition in Paris last summer, they will soon displace the common lucifer, in virtue alike of their manufacture being much less injurious to the health of the workmen who make them, and to the property of those who use them.

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* From the Lond. Journal of the Society of Arts, No. 194.

For the Journal of the Franklin Institute.

Particulars of the R. M. Steamer Persia, (*Cunard Line.*)

Hull and Machinery built by R. Napier & Sons, Glasgow, 1855. Intended service, Liverpool and New York.

HULL.—			
Length on deck, from fore part of stem to after part of stern post, above the spar deck, .		390 feet.	
" of heel and fore rake, .		360 "	
Breadth of beam at midship section, .		45 "	
" " over wheel-houses, .		71 "	4 inches.
Depth of hold, . . .		29 "	8 "
Length of fire rooms, . .		12 "	
Draft of water at load line, . .		23 "	
" " below pressure and revolutions,		18 "	
Tonnage (builders), .	3586 78·94.		
Masts and rig—barque.			
ENGINES.—Side lever—			
Diameter of cylinders, . .			100½ inches.
Length of stroke, . . .		10 feet.	
Maximum pressure of steam in pounds,	21.		
" revolutions per minute,	18.		
Distance between centres of cylinders, .		15 feet	10 inches.
" " levers, .		11 "	3 "
BOILERS.—Eight—Tubular.			
Number of furnaces, . .	10.		
Length of grate bars, . . .		8 feet	4 inches.
Diameter of air pumps, . .			60½ "
Stroke " " . .		5 "	1 "
Diameter of main centres, . .		4 "	5 "
Nominal horse power (Admiralty), .	850.		
PADDLE WHEELS.—			
Diameter, . . .		40 feet.	
Length of blades, . .		10 "	8 inches.
Number " . .	38.		
Height of water wheel shaft, .		24 "	3 "

Remarks.—Floor, *molded*, 10 inches, *sided*, $\frac{9}{16}$ths. Distance of frames apart, *at centres*, 18 and 20 inches. Plates, $\frac{15}{16}$th to $\frac{3}{4}$-inch thick. Rivets, 1 and $\frac{7}{8}$-inch diameter, $3\frac{1}{2}$ inches apart. Keel, 13 × $4\frac{1}{2}$ inch, keelson form. Has six water tight bulkheads.

C. H. H.

For the Journal of the Franklin Institute.

Particulars of the Steamer Everglade.

Hull built by Sneden & Whitlock. Machinery by Morgan Iron Works, New York, 1856. Intended service, Charleston to Florida.

HULL.—

Length on deck, from fore part of stem to after part of stern post, above spar deck,		173 feet.	
Breadth of beam at midship section, above main wales (molded),		28 “	8 inches.
Depth of hold,		8 “	
Draft of water at load line,		4 “	6 “
Area of immersed midship section at this draft,		110 sq. ft.	
Fuel hold—50 cords pine wood.			
Tonnage,	475.		
Masts and rig—One mast with foresail and jib.			

ENGINES.—Inclined—Direct.

Diameter of cylinders,			32 inches.
Length of stroke,		8 feet.	
Maximum pressure of steam in pounds,	25.		
Cut-off—half-stroke.			

BOILER.—One—Single return flued.

Length of boiler,		25 feet.	
Breadth “		11 “	6 inches.
Height “ exclusive of steam chimney,		11 “	6 “
Number of furnaces,	2.		
Breadth “		5 “	2 “
Length of grate bars,		7 “	
Number of flues,	15.		
Internal diameter of flues,		18, 13, and 19	“
Length of flues,	18 ft. 3½ in., and	13 feet	3 “
Diameter of smoke pipe,		4 “	
Height “ “		32 “	
Draft,	Natural.		

PADDLE WHEELS.—

Diameter,		28 feet.	
Length of blades,		6 “	
Depth “		1 “	10 inches.
Number,	28.		

Remarks.—Floor timbers at throat, *molded*, 14 in., *sided*, 4 in. Distance of frames apart *at centres*, 12 in. Hull strapped with diagonal and double laid iron braces, $3\frac{1}{2} \times \frac{1}{2}$-inch. Keel, 2 inches deep. C. H. H.

*Improved Process for the Manufacture of Phosphorus.** By HUGO FLECK.

In the course of last year the author published a separate memoir, in which he described an improved process for the manufacture of phosphorus. By this process 100 lbs. of fresh bones furnish 6 to 7 lbs. of phosphorus, and 10 to 20 lbs. of gelatine, whilst the older process only gave 4 to 5 lbs. of phosphorus.

The bones, properly cleaned and broken up, and freed as much as possible from fat, are macerated with dilute muriatic acid, by which chloride of calcium and acid phosphate of lime ($CaO, 2HO, PO_5$) are produced. The maceration is continued until as much as possible of the earthy matter is extracted, and only the cartilage remains. The latter is watered, immersed in lime water, again washed, and then employed in the production of bone-gelatine, which turns out very pure and clear.

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* From the Lond. Chem. Gaz., No. 330.

The fluid containing the chloride of calcium and the acid phosphate of lime is evaporated. This operation is carried on in glazed stone-ware pans, as metal pans do not present sufficient resistance to the action of the acid fluid. The evaporating pans are heated by the flue from the phosphorus furnace, and the evaporation is continued until the fluid marks about 38° B. It is then allowed to flow out of the pans and cool, when acid phosphate of lime separates in fine crystals. A further quantity of these is obtained by the evaporation and cooling of the mother-liquor. From the mother-liquor of the second crystallization the portion of phosphate still dissolved in it is obtained by mixing it with milk of lime, when phosphate of lime separates, which is treated with muriatic acid, like the residue from the retorts. The acid phosphate of lime, which cannot be washed on account of its solubility, is freed as far as possible from mother-liquor, either by pressing it between cloths, or by spreading it upon a porous plate and producing an imperfect vacuum beneath the latter, when the atmospheric pressure forces the mother-liquor through the plate, upon which the salt forms a white nacreous mass, which crackles between the fingers. This is warmed and mixed with one-fourth of powdered charcoal, passed through a sieve, and then put into the retorts.

For retorts, the author recommends clay cylinders, which, like the retorts of the gas-houses, are placed in fives over each fire. The tubes from each five retorts open into a common receiver; this is of the shape of a muffle, and is placed in a channel through which a stream of water is allowed to flow. The first receiver is connected with a second, similarly arranged. The fuel used is coke and coal. If the acid phosphate of lime was not well freed from the mother-liquor, which contains chloride of calcium, muriatic acid will be formed during the distillation, and thus a smaller amount of phosphorus will be obtained. The mixture of phosphate of lime and charcoal remaining in the retorts is reduced to ashes on iron plates, which are laid on the phosphorus furnace and heated by its fire. The residue of phosphate of lime is then mixed with the phosphate formed by the addition of lime to the mother-liquor, and treated with muriatic acid. By this means chloride of calcium and acid phosphate of lime are again produced; the latter is separated and worked for phosphorus. In this way the entire amount of phosphorus in the bones, with the exception of unavoidable loss, is obtained.

The cartilage, isolated from the bones by means of muriatic acid as above described, is covered with water and exposed to a current of steam, until the solution forms a concentrated jelly, and this, when brought into form dries on cooling into solid cakes. The phosphate of lime still in the membranes gives the gelatine a milky appearance, which is often increased by the addition of white lead, and the gelatine is then sold under the name of patent gelatine. The objections against the bone gelatine obtained by extraction with acids, which have always prevailed amongst the tradespeople, arose from the employment of acids of too great strength. By the use of a muriatic acid of 7° B. at a moderate heat, and subsequent complete neutralization with lime-water (but not with milk of lime), we have not so much to fear a decomposition of the animal tissues, as that it would cause a diminution of the total product. A far greater injury is done by boiling the gelatine too long, and the treatment by steam is now justly recognised as a step in the manufacture of gelatine.—*Polytechn. Centralblatt*, 1856, p. 681.

For the Journal of the Franklin Institute.

Particulars of the Steamer Christoval Colon.

Hull built by Sneden & Whitlock. Machinery by Morgan Iron Works, New York, 1856. Intended service, South Coast of Island of Cuba.

HULL.—			
Length on deck, from fore part of stem to after part of stern post, above spar deck,		180 feet.	
Breadth of beam at midship section, above the main wales (molded),		36 "	
Depth of hold,		8 "	
Draft of water at load line,		3 "	
Tonnage,	450.		
Area of immersed section,		103 sq. ft.	
Contents of fuel hold—50 cords pine wood.			
Masts and rig—one mast—foresail and jib.			
ENGINE.—Vertical overhead beam.			
Diameter of cylinders,			48 inches.
Length of stroke,		10 feet.	
Maximum pressure of steam in pounds,	15.		
Cut-off—½-stroke.			
BOILERS.—Two—Single return flued.			
Length of boilers,		24 feet.	
Breadth "		8 "	6 inches.
Height " exclusive of steam chimney,		8 "	3 "
Number of furnaces in each boiler,	2.		
Length of grate bars,		6 "	
Number of flues,	14.		
Internal diameter of flues,			15, 15½, and 9¼ "
Length of flues,		13 and 10 feet	5 "
Diameter of smoke pipe,		4 "	4 "
Height " "		34 "	
Draft,	Natural.		
PADDLE WHEELS.—			
Diameter,		28 feet.	
Length of blades,		7 "	
Depth "			24 inches.
Number "	24.		

Remarks.—Floor timbers at throat, *molded*, 14 inches, *sided*, 4 inches. Distance of frames apart *at centres*, 12 ins. Hull strapped with diagonal and double laid iron braces, 3½ × ½-inch. Keel, 1 inch deep.

C. H. H.

The Chemistry of Iron.—On the Composition of some varieties of Foreign Iron.[*] By F. A. Abel, Director of the Chemical Establishment of the War Department.

There are few subjects of practical importance that have, during the last twelve months, attracted general attention in this country to the same extent as the question of the manufacture of iron ordnance. While numerous plans have been proposed, discussed, and tried for constructing cannon, either of wrought iron, steel, or mechanical combinations of iron material of different kinds, which shall be capable of throwing larger and heavier projectiles than those hitherto used, the question at issue has gradually become one of more general interest, involving considerations intimately connected with the metallurgy of iron, in consequence of the conclusions deduced from the experience in the late war, that the conditions necessary for obtaining a durable and uniform material for iron guns are as yet far from being fully determined.

The American government has lately published a collection of reports, containing some interesting and important observations connected with the manufacture of iron ordnance, though it does not appear that the researches carried on in that country, or the experience gained by the directors of gun foundries belonging to various continental states, have as yet effected much more than the provision of a number of data relating to the nature and quality of iron employed, the different methods of treating the metal and of casting the gun, and the effects of mechanical tests, and of the explosive force of powder upon iron ordnance. There is little doubt that the accumulation of such data, and extensive experiments suggested by their comparison, will ultimately lead to the establishment of the conditions necessary for insuring to iron ordnance uniformity and durability.

The collection in this country of such data as those referred to has hitherto been a matter of great difficulty, from the circumstances that iron ordnance were obtained by Government from various private sources; that no special conditions have been observed in the selection or treatment of metal for ordnance; that no records of the material employed by the different manufacturers have been preserved, and that no system of tests, physical or chemical, has been applied to the metal composing the guns, beyond the regulation proof to which ordnance were submitted before their acceptance from manufacturers. It is obvious, also, from these circumstances, that no uniformity in the iron guns used in this country could be expected.

Now that Government has determined to take the manufacture of iron ordnance into its own hands, the most serious obstacles to the perfection of these important arms in England are set aside, and the introduction of a complete system of testing and of record, together with the results of a very extensive series of experiments, on a sufficient scale, which have already been commenced, will, it is hoped, furnish important contributions to our knowledge of the constitution and mode of treatment of iron, best adapted for the manufacture of ordnance.

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[*] From the Lond. Artizan, December, 1856.

In carrying out the system of experiment determined upon by Government, attention has been directed, in the first place, to iron reduced from its ores by charcoal, this being the material employed exclusively, in some continental States, and to a very great extent in others, in the manufacture of iron ordnance. Much stress is laid, by many authorities on the continent, upon the greater fitness, for this purpose, of that description of iron than of the best hot-blast, or even of cold-blast iron, smelted with coal or coke. It appeared, therefore, naturally the first step, in comparative experiments with various materials, to ascertain the nature of the iron composing the most durable guns manufactured in those countries, and to determine, by comparative experiments here, whether guns manufactured from charcoal iron exhibit great superiority over those made *according to the same system* of iron reduced from its ores by mineral fuel. Various specimens of foreign charcoal pig iron, and cannon of that metal made in France, Belgium, and Sweden, have been collected for comparative examination, and considerable quantities of charcoal-iron, procured from Nova Scotia, Sweden, and America, have been purchased, for experimental purposes. The results obtained, up to the present time, are principally those furnished by the analysis of several of these specimens; and I venture to submit these to the Chemical Society, as they exhibit some points of interest, and may also serve, to others engaged in similar inquiries, as additional means, to those already existing, of comparing the constitution of the varieties of charcoal-iron with that of other descriptions of iron.

It is unnecessary, in the present instance, to enter into analytical details; but, as various methods are employed by different chemists, for determining the most important constituents in iron, it may be advisable to furnish a brief outline of those adopted in performing the subjoined analyses.

The *graphite* was determined by digesting the finely-pulverized iron with concentrated hydrochloric acid, and boiling the residue for some time with a moderately strong solution of potassa: the graphite was collected, washed, dried, and weighed. It was afterwards placed in a capsule and heated to redness in a muffle, until the whole of the carbon was burnt off. The weight of the slight incombustible residue which was generally obtained was deducted from the weight of the graphite.

For the determination of the *total amount of carbon*, the iron was reduced to an extremely fine state of division; it was then first mixed with about twice its bulk of fine sand, or powdered glass, and afterwards with a mixture of chromate of lead and chlorate of potassa. The combustion was conducted in the usual manner, a current of oxygen being frequently employed.

The proportion of *silicium* was ascertained by acting upon the finely-divided metal with concentrated hydrochloric acid, evaporating to dryness, and digesting the residue with hydrochloric acid. The insoluble portion was collected upon a filter, washed until free from iron, dried, and ignited until the whole of the carbon was burnt off. The silicic acid thus obtained was digested with solution of potassa, after its weight had been determined. If any insoluble residue was obtained, its weight was deducted from that of the silicic acid.

To determine the proportion of *sulphur*, hydrochloric acid was allowed to act very slowly upon fragments of the iron, in a suitable apparatus, and the gas generated was passed through a slightly acid solution of acetate of lead. The sulphide of lead produced was collected, washed, and ultimately weighed as sulphate of lead.

The *phosphorus* was determined by digesting, in nitrohydro-chloric acid, fragments of the metal, of the size of small peas, evaporating the solution to dryness, digesting the residue with hydrochloric acid, and separating the insoluble from the soluble portion. The hydrochloric solution was partly neutralized by sesquicarbonate of ammonia, and the greater part, if not the whole, of the sesquichloride of iron reduced to protochloride, by sulphite of ammonia. Solution of acetate of ammonia was then added in excess, and afterwards a small quantity of solution of sesquichloride of iron. The phosphate of lime was precipitated by boiling, collected, and dissolved in hydrochloric acid, and decomposed by sulphide of ammonium. The phosphoric acid was estimated in the usual manner, by pyrophosphate of magnesia.

In the following Table is represented the per centage composition of several specimens of iron, reduced from its ores by charcoal, as calculated from the analytical results :—

TABLE I.

Composition of Pig Iron Smelted with Charcoal obtained from

	NOVA SCOTIA.			AMERICA.			FRANCE.	SILESIA.	
	Grey.	Mottled.	White.	Grey.	Mottled.	White.	Grey.	White, *very crystalline.*	White, *less crystalline.*
Specific gravity,	7·120	7·540	7·690	7·159	7·540	7·675	7·000	7·531	7·604
Iron,	95·20	95·35	95·25	94·87	96·35	96·55	95·18	93·45	90·75
Combined Carbon,	—	1·72	2·96	·04	1·14	2·79	—	4·94	3·62
Graphite,	3·11	1·38	—	3·07	1·50	—	3·40	—	—
Silicium,	1·11	·26	·21	1·80	·79	·32	·80	·75	·25
Sulphur,	·01	·03	·02	trace.	·01	·06	·03	trace.	trace.
Phosphorus	·13	1·30	1·53	·22	·20	·17	·45	·12	3·26
Manganese,	·25	trace.	—	trace.	trace.	trace.	—	5·38	2·00
Copper,	—	—	—	trace.	trace.	trace.	—	·24	trace.
	Traces of Titanium and Cobalt.						Traces of Arsenic and Chromium.	Traces of Cobalt.	

The specimens of white iron from Silesia differ from one another in several respects, and to such an extent, as to prove that they were obtained from different ores. Both were very hard and brittle; but the ore containing the largest amount of manganese exhibited a foliated structure and brilliancy of lustre, very similar to that of refined antimony, while the other specimen, rich in phosphorus, was less brilliant and far more compact. These irons were proposed for admixture with dark grey iron; but it was considered that they could not be advantageously employed for this purpose.

The French iron examined was a specimen of the metal reduced by charcoal from hæmatite ores, at the Government cannon foundry of Ruelle, and employed exclusively in admixture with charcoal iron also reduced from similar ores in the neighborhood, for the manufacture of ordnance. It was dark, soft, fine-grained, and uniform in texture. In its general characters it was similar to the Swedish grey iron analyzed, though exhibiting a superiority over the latter in reference to the amount of silicium it contains.

The specimens of American and Nova Scotia iron analyzed were taken as average samples from large parcels of the metal purchased by Government for experimental purposes.

The different varieties of iron from each source exhibit such differences in their composition as are generally observed in irons reduced from the same ore under modified conditions. Both the Nova Scotia and American irons are of excellent quality, and furnish the best results when submitted to physical tests. Comparative trials are about to be made of their merits as gun-metal.

The subjoined Table exhibits the results of the analyses of four specimens, from guns of foreign manufacture.

TABLE II.

Composition of Iron Gun Metal from

	BELGIUM.	FRANCE.	SWEDEN.	RUSSIA.
Specific gravity,	7·250	7·250	7 050	7·135
Iron, ...	95·61	96·02	95·87	94·36
Combined Carbon,	·78	1·03	·18	·47
Graphite, . . .	2·12	1·87	2·62	2·83
Silicium, . . .	·09	·35	1·19	1·10
Sulphur, . . .	·06	·03	·08	·02
Phosphorus, . .	·29	·45	·11	·37
Manganese, . .	·15	·25	trace.	·85
Titanium, . .	traces.	traces.	trace.	trace.
	Traces of Chromium, Arsenic, Zinc, and Copper.	Traces of Chromium and Tin.	Traces of Chromium.	Traces of Tin.

The Swedish metal examined has great resemblance to that composing the Russian gun, which was one of those lately captured and selected for experiment. A severe proof to which this gun was submitted showed that the metal composing it was of excellent quality.

The Swedish metal was of a uniform light grey color, while the Russian gun exhibited a slightly mottled appearance. Both contained the graphite in a finely divided state. It is worthy of remark, that the strength and durability of Swedish iron guns is found to be variable; which circumstance is ascribed to the very general practice of casting the guns directly from the blast furnace, instead of first submitting the metal to treatment in reverberatory furnaces.

The specimen of French gun metal was obtained from the cannon foundry at Ruelle. It resembled, in a remarkable manner, several specimens of iron gun metal obtained from the cannon foundry at Liège, of which the composition of an average sample is also given in the above Table. Both kinds were mottled iron of very uniform character, exhibiting a short and regular fracture, and a fine and compact structure. Their specific gravities are identical, and the differences exhibited in their composition are but slight. For the preparation of the French gun metal, a mixture of various descriptions of charcoal pig iron, obtained at Ruelle, is made with grey pig iron, from other similar iron works in the neighborhood (*e. g.* from *La Chapelle* and *Etouars*), with old French cannon, and with the "dead heads" from former castings. By a protracted treatment in reverberatory furnaces, these metals undergo thorough mixture, and purification at the same time, and are converted into the uniform mottled metal above referred to. The fuel used for the remelting and mixing is Newcastle coal.

At the Belgian Government cannon foundry a certain proportion of hot-blast iron, smelted with coke, is employed in admixture with old cannon, "dead heads," and charcoal pig iron, obtained from various smelting works, more particularly in the neighborhood of Charleroi. The fuel used for the remelting is a semi-anthracite coal, from Belle Vue, in the neighborhood of Liège, and has the following per centage composition:—

Carbon,	85·56
Hydrogen,	4·20
Oxygen,	2·40
Nitrogen,	1·92
Sulphur,	1·00
Ash,	4·92

The per centage of phosphoric acid in the ash is 1·60.

The same care is taken to ensure the production of a metal of uniform structure as at Ruelle; and the excellent results obtained by the proof of the guns, and by the mechanical tests to which the metal is submitted, bear very strong evidence in favor of the superiority of iron of the particular constitution and structure produced in Belgium and France, for the manufacture of guns, over other kinds of iron, even equal to it in chemical quality.

Unquestionably the repeated exposure of grey iron to a moderately oxidizing action, in the reverberatory furnace, has the effect of improving its quality, and of removing one of the impurities most objectionable in iron which is to possess tenacity and elasticity—namely, silicium. In experiments lately made, in connexion with some patent processes for improving the quality of iron, it was found that the oxidizing action of air upon highly heated iron had the effect of removing the silicium entirely, before the amount of carbon existing in the metal was diminished in any sensible degree. The close-grained and very uniform structure of the iron produced by the mixing and remelting processes, on the Continent, and the very finely divided condition in which the graphite exists in the iron, are elements affecting the durability of the gun metal, of equal importance to the purity of iron. Some pieces of iron ordnance which have either burst upon proof, or after having been but a short time in use, and the metal composing which was of good quality and even of an unusually pure description, evidently owed their incapability to resist the force of gunpowder to the comparatively loose structure of the metal, and to the existence of the graphite in large scales. There are, moreover, various points to be taken into consideration, in connexion with the *method of casting guns*, which cannot be entered into here; but which, doubtless, greatly influence their physical structure, and, consequently, their durability.

It would be premature to attempt a comparison between the merits of charcoal iron and those of the better qualities of British coal-blast iron, as materials for ordnance, from results of analyses alone; but thus much is certain, that iron smelted with mineral fuel may be obtained in abundance in this country, which contains not more phosphorus or sulphur than are found in average specimens of charcoal iron, and that abundant proofs already exist of the ease with which silicium may be removed from pig iron, by judicious treatment. It may, therefore, be confidently expected that future experiments on the casting of ordnance, with various kinds of iron, will prove that we are not dependent upon a supply of charcoal iron, for the production of durable guns.

As an appendix to this communication, I beg to lay before the Society the results of an analysis of a specimen of the cast steel manufactured by Krupp, of Essen, of which such beautiful specimens were exhibited at the Paris Exhibition of 1855.

This cast steel was proposed, by M. Krupp, as a material for ordnance, as far back as 1847, and the first small gun (a 3 pr.) cast of it was submitted to very severe tests, in Berlin, in 1849, and finally proved to bursting. A 12-pr. gun of the same material, was afterwards sent for trial to this country (early in 1855), after having likewise withstood very severe tests. At about the same time, a cylinder of the cast steel was sent from Essen, and bored by Messrs. Walker, of the Gospel Oak Works, to the calibre of an 8-inch gun. Its breech was fitted with a cast iron case, or jacket, the thickness of which was 10 ins. at the breech, and 8·5 in front of the trunnions. The weight of the gun complete was 8 tons 5 cwt. The case was in contact with a steel barrel only at its two extremities, at the breech and the middle of the barrel; at the latter place a wrought iron wedge-ring was fitted into the barrel, and fixed to the jacket by screws. This gun was proved at Woolwich, but bursted the first time it was fired. The probable cause of this unexpected result has been a subject of some public discussion in Germany, but there is little doubt that it was due to the injudicious form of projectile (weighing 259 lbs.) which the parties who proposed to Government the experiments with cast steel, and provided the gun for trial, insisted upon employing for the proof.

The gun was broken into ten large pieces, and a number of small fragments. The various fractures of the cast steel did not exhibit any imperfections, to which the bursting of the gun could have been ascribed.

The metal was very uniform, compact, and hard. A fragment was selected for analysis, and furnished the following results:—

One hundred parts contained—

Iron,	98·05
Combined carbon,	1·18
Silicium,	0·33
Phosphorus,	0 02
Manganese,	*trace.*
Cobalt and Nickel,	0·12
Copper,	0·30

No sulphur was detected.

The specific gravity of the specimen analyzed was found to be 7·836. The preceding paper is a condensed report of a communication read before the Chemical Society.

*Du Tremblay's Combined Ether and Steam Engine.—Burning of a French Steamer at Bahia.**

"The screw steamer *La France* was built at Marseilles about two years ago, and was first employed in the transport of troops to the Crimea. Her hull and several of her main divisions were of iron; her tonnage was 2200 tons, and the power of her steam and ether boilers and engines, 350 horses. She was fitted up with apparatus for the use of the vapor of ether as well as steam from coal, according to the system of M. Du Tremblay. It is stated that, by this plan, 15 tons only of coal and 60 litres of ether are required for the 350 horse engines for each 24 hours; whereas, if coal only were used, a consumption of nearly three times that weight would be necessary. It will be seen from this, that if the system can be safely adopted, it would prove a disideratum for long voyages. In the present instance, there is no doubt that the conflagration was originated by the want of care about the ether, as will be seen when I go into particulars. *La France* was the second vessel of the Marseilles line of steamers to the Brazils. She was on the outward voyage, and anchored in the Bay of Bahia on the 25th of September. She was preparing for her continued voyage to Rio de Janeiro on the 28th; but at about half-past ten o'clock on the night of the 27th, three men were engaged with lanterns in shifting luggage or cargo on the lower deck, when they smelt a strong odor of ether; and thinking that some accident had taken place, two of them succeeded in extinguishing their lights, but the third in the attempt to do so, upset his lamp, and set fire to some ether alleged to have been spilt upon the floor. One man was seriously burnt, the other two slightly. I could obtain no explanation of the reason why ether should have been in such an unsafe place. The ship was instantaneously in flames; guns were fired, bells were rung, the news was conveyed to Captain St. Brue, the commander of the ship, who was on shore with the consignees, arranging for the departure on the morrow. The local authorities of the city, the officers from the arsenals, and from the vessels in port, hastened to afford all the assistance in their power; the passengers and their baggage were got safely ashore, and about three o'clock

* From the Lond. Artizan, Dec., 1856.

in the morning the fire seemed to be entirely put out, and the captain dismissed the assistance given to him. Notwithstanding this confidence, the flames again broke out with fury, and this time there was not the means of subduing them. It was found impossible to save the ship; and owing to the fear of explosion of the ether, which was known to be in cisterns on board, it was found impossible to get lighters to go alongside to take away the cargo, or to make the tug-boat available to tow the blazing ship into shallow water. It was determined, therefore, to sink her where she lay; and, about ten in the morning, the plugs in the ship's bottom were drawn out, and the vessel sunk, leaving her chimney and awning stancheons above the water level. Just before the *Avon* passed through Bahia, the hull of the sunken vessel and its contents had been offered by public auction, and sold for about £5000. Attempts are intended to be made immediately for the raising of the vessel, her machinery, and the cargo; and the purchaser is sanguine of being able to realize a large sum by the transaction. The vessel was insured for a sum of about £50,000. I avail myself of the opportunity of giving the following brief description of the system of Du Tremblay, which I was favored with by an engineering friend:—The engine for working by the vapor of ether, invented by Du Tremblay some three years ago, consists of a large working cylinder, with a piston as usual, but having an outer casing, or, as we should call it, a steam jacket, into which the used steam is discharged from the cylinder. This contains a number of tubular chambers of an oblong section, say about 1½ in. by ½ in. in area. These tubes may be considered as constituting the ether boiler, as they contain that liquid; and, being surrounded by the steam, vapor of ether is generated at such a pressure as to be available for working a piston and machinery, much in the same way as in the steam engine."—*Manchester Guardian.*

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*On the Preparation of Drying Oil.** By Prof. R. Wagner.

The author repeatedly prepared protoborate of manganese for lacquerers, in accordance with the directions of Barruel and Jean. He effected its precipitation whilst hot, and thus obtained it of a coffee-brown color, and consequently containing much oxide, but still always of remarkable efficacy. As, however, Barruel and Jean expressly observe that the action is proper to the protosalts, the author endeavored to obtain it perfectly free from oxide, and for this purpose effected the precipitation with borax cold. He obtained a snow-white powder, but this furnished no varnish. He therefore returned to the previous mode of preparation with the assistance of heat, and found that it was obtained of the darkest brown, and also of the strongest action, when both the solutions of sulphate of manganese and borax were diluted as much as possible and mixed boiling. The siccative action upon the oil must therefore be ascribed to the oxide, and not to the protoxide.

By further experiments the author found that the boracic acid is quite superfluous, and that free oxide of manganese or its hydrate is as efficacious as the borate. The oil need only be heated for a very short time

* From the Lond. Chem. Gaz., No. 338.

(about a quarter of an hour) with about one-eighth per cent. of oxide or hydrated oxide of manganese. The heat applied need not approach the boiling-point by a long way; but no general temperature can be given, as new oil has a much higher boiling-point than old. The siccative quality, however, increases with the heat. But as the oil becomes darker and thicker in proportion to the heat to which it is exposed, it is the best plan in general to remove it from the fire as soon as it clears and begins to fume very slightly. Streaks of it now become firm in twenty-four hours. To obtain the drying oil of a very pale color, it must be heated still less. The drying is thus retarded several hours, but the color has scarcely become perceptibly brownish, whilst in the former case it always acquires a chestnut-brown color.

The author obtained a wine-yellow oil, quite unaltered, without heat, by mixing 1 per cent. of hydrated lime with a linseed-oil four years old, which dried by itself in three days. After being frequently stirred for two days, a streak of it was perfectly firm in twenty-four hours. Oil of the same year, however, did not become siccative even by boiling with lime.

The oil dissolves very little of the small quantity of oxide of manganese, and the salt when removed may be repeatedly used in the preparation of drying oil. When prepared oil is mixed with an equal weight of crude oil, it requires nearly twice as long to dry; with twice the quantity, twenty hours longer; and with three times the quantity, another twelve hours; but the time necessary for the solidification of the coating gradually diminishes a little by long standing.—*Kunst- und Gewerbeblatt für Bayern*, 1856, p. 314.

On the Preparation of Chemically-pure Sulphuric Acid.[*]

By F. Vorwerk.

Some time ago Russegger described a method in which, by a particular arrangement of the retorts, sulphuric acid may be distilled by boiling without thumping, and the rectification of the crude acid may be effected without the employment of platinum wire. Instead of this the author recommends the following process, which fulfils the same purpose, and dispenses with all further particular arrangements.

Into a long-necked plain retort, which had already served several times for the preparation of nitric acid, 5 lbs. of slightly brown English sulphuric acid, of spec. grav. 1·832, and free from arsenic, were put. The retort was put upon a layer of sand of the depth of a finger in the sand-bath, and surrounded with sand, so that it was buried up to the neck. A long-necked flask served as a receiver: it was simply pushed over the neck of the retort without any luting. Commencing with a moderate heat, this was gradually raised until the sand-bath became red hot, during which the distillation went on quite regularly without any thumping. Notwithstanding the heat to which the retort was exposed, the receiver did not require to be cooled until after six hours' working, and even then only by wrapping a wet cloth round the neck. The distillate was removed from time to time, and tested as to its purity and specific gravity. The first 5 ozs. that passed, had a specific gravity of 1·20, and exhibited no impurity except a considerable quantity of sulphurous acid. The second portion of 3½ ozs. of distillate, with a specific gravity of 1·75, still contained a trace of sulphurous acid. A third portion of 2½ ozs. was pure, and had a specific gravity of 1·850.

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[*] From the Lond. Chem. Gaz., No. 338.

Fourth portion of 1½ lb. spec. grav. 1·855
Fifth portion of 13 ozs. spec. grav. 1·860
Sixth portion of 9 ozs. spec. grav. 1·885

With this the distillation was concluded, to enable the contents of the retort to be examined. The uninjured retort contained the remainder of the sulphuric acid as a limpid fluid with a white sediment (persulphate of iron), from which no doubt ½ lb. of pure distillate might still have been obtained.

In such distillations, particular attention is to be paid to the quality of the retort. It is always advisable to anneal the retort before using it, by heating it as strongly as possible in the sand-bath, and letting it cool slowly and completely therein.—*Neues Jahrbuch für Pharm.*, v. p. 257.

Action of Tannin upon Skin.

The investigations which M. Payen laid before the Academy of Sciences (*Paris*), are only the prelude to an attempt to get at, if it be possible, the knowledge of the phenomena which are going on during the operation of tanning, and to establish a theory of this operation, still so obscure to the chemist. In this first part, he has endeavored only to examine thoroughly and show the generality of a fact, which he had observed several years ago. This fact is, that there exist in the skin two portions which present different properties, when they have undergone the action of tannin. One of these is easily disaggregated, soluble in ammonia-water; the other preserves its fibrous texture, and resists the action of the re-agent, although frequently renewed. The saturation of the skin by the tannin takes place long before the time practically required for good tanning; and requires for the two parts much less tannin than gelatine. The compound formed with the tannin, by the less cohesive parts of the skin, when it has been dissolved in ammonia, is changed in dissolving; it undergoes, besides, a considerable loss of nitrogen during its evaporation to dryness. The effects of long-continued tanning cause the gradual solution of the less cohesive portions united with the tannin, and consequently a relative increase of the quantity of resisting fibrous material. The product, in this case, must therefore be both more pliable and more tenacious. The friable soluble portion which remains in the tanned leather is unstable; in dissolving, it may withdraw considerable quantities of the azotized substance; and it is thus, perhaps, that the less cohesive part of the skin is removed during the long operations of tanning. These are, in substance, the remarks which result from the observations and analyses reported in detail by M. Payen. The author proposes to examine successively all the operations of tanning, and to study separately the effects produced by lime, soda, by ammonia, the formation of which is determined by the foregoing bases, by dilute sulphuric and lactic acids, &c.—*L'Institut, 26th November.*

Synthesis of Carburets of Hydrogen.[*] By M. BERTHELOT.

1. The action of a mixture of sulphuret of carbon and sulphuretted or phosphoretted hydrogen upon copper at a dull red heat, produces hydrogen, marsh gas, $C^2 H^4$, a considerable quantity of olefiant gas $C^4 H^4$, and a trace of naphthaline.

The proportion of olefiant gas may be rendered more considerable by the action of a mixture of sulphuret of carbon, marsh gas, and carbonic oxide on iron. In these circumstances, the proportion of olefiant gas formed may be such that its carbon will be equal to one-sixteenth of the carbon of the sulphuret decomposed.

The marsh gas formed in these experiments could be isolated by the use of solvents. The olefiant gas was collected in bromine, and disengaged in a state of purity from the bromine compound by a process which will be presently indicated ; this olefiant gas was afterwards converted into crystallized sulphovinate of baryta and characteristic benzoic ether.

Thus the synthesis of alcohol by means of the simple bodies of which it consists may be regarded as an accomplished fact, for sulphuret of carbon is obtained by the direct union of carbon and sulphur.

2. In the dry distillation of formiate of baryta, carburetted hydrogen gas, olefiant gas, $C^4 H^4$, and propylene, $C^6 H^6$, are formed. Hence, it follows that these two carburets and the corresponding alcohols may be obtained by complete synthesis ; for I have shown, on the one hand, that the formiates may be prepared by means of oxide of carbon, and on the other, that the preceding carburets may be converted into the corresponding alcohols by the intervention of sulphuric acid or of the hydracids.[†]

3. If carbonic oxide and purified marsh gas be passed together into a tube heated to dull redness, a small quantity of propylene, $C^6 H^6$, is obtained. Marsh gas alone does not furnish anything of the kind under the same conditions.

4. In the dry distillation of acetate of soda, olefiant gas, $C^4 H^4$ (in very small quantity), propylene, $C^6 H^6$, butylene, $C^8 H^8$, and a little amylene, $C^{10} H^{10}$, are formed. The carbon contained in these various carburets may rise to one-twentieth of the total carbon contained in the acetate. It will be observed that the acetates are prepared simply by means of the alcohol derived from the olefiant gas which is formed in the preceding reaction.

5. The various carburets just referred to were condensed in bromine, and studied separately after being disengaged in a pure state by the following process. The bromine compound is heated to about 482° F., in a hermetically-sealed tube, with copper, water, and iodide of potassium. By

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[*] From the Lond. Chem. Gaz., No. 335.

[†] Propylene combines directly with muriatic, hydrobromic, and hydriodic acids, forming the corresponding ethers.

this process, olefiant gas, propylene, &c., may easily be regenerated from their bromides. If the copper be omitted, the hydrurets of the carburets of hydrogen are obtained; thus the bromide of olefiant gas, $C^4 H^4 Br^2$, furnishes the carburet $C^4 H^6$, and the bromide of propylene, $C^6 H^6 Br^2$, gives the carburet $C^6 H^6$. This is a very general process of inverse substitution.

6. From the preceding facts, and the relations which exist between the carburets of hydrogen and the alcohols on the one hand, and the alcohols and the other organic compounds on the other, we may regard the complete synthesis of a great number of organic compounds as an accomplished fact.—*Comptes Rendus*, July 28, 1856, p. 236.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, December 18th, 1856.

B. Howard Rand, President, pro tem., in the chair.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Letters were read from the Royal Society of London, and the Royal Institution, London.

Donations to the Library were presented from the Commissioners of Patents; The Society of Arts, Manufactures, &c.; The Zoological Society, London; The Royal Irish Academy, Dublin; The Ecole Imperiale des Mines, Paris; K. K. Geologischen Reichsanstalt, Vienna; Hon. R. Brodhead, United States Senate; The Smithsonian Institution; Hon. Commissioner of Patents, and Thomas U. Walter, Esq., Washington City, D. C.; The Governor of Pennsylvania; The American Institute, City of New York; The Union College, Schenectady, New York; Messrs. Charles E. Smith, D. and E. Parrish, Philip Price, Henry Quig, and Professors Jno. F. Frazer, and J. A. Kirkpatrick, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer's statement of receipts and payments for November was read.

The Board of Managers and Standing Committees reported their minutes.

The Committee on Exhibitions presented so much of their report on the late Exhibition as refers to specimens of De Laines manufactured by the Manchester Print Works, New Hampshire, for which they recommend the award of a Gold Medal, and also,

To the specimens of De Laines manufactured by the Hamilton Woolen Co., Southbridge, Mass., and the specimens of Chemicals by Powers & Weightman, of Philadelphia, for which they recommend the awards of the Recall Gold Medals.

The Chairman also read the report on the Chandeliers, Lamps, &c., by Cornelius & Co., of Philadelphia.

On motion the awards were made in accordance with the report.

Seventy-six resignations of membership in the Institute, were read and accepted.

Candidates for membership in the Institute (141) were proposed, and the candidates proposed at the last meeting (22) were duly elected.

Nominations were made for Officers, Managers, and Auditors of the Institute for the ensuing year.

On motion, it was

Resolved, That the polls for receiving the votes of the members of the Institute for Officers, Managers, and Auditors for the ensuing year, at the Annual Election to be held on Thursday, January 15th, 1857, shall be opened at 3½ o'clock, and closed at 8 o'clock, P. M., and that seven members be appointed by the President a committee to receive the votes, and report the result thereof.

Mr. Maskel's patent sliding keel was exhibited and explained to the members. It consists of a plate of iron, or other suitable metal, which is moved vertically in a recess made for it in the keel. A link at each end attaches the plate to the keel, provision being made by slitting the pin-holes of the links, to allow for the raising or lowering of the plate, which is accomplished by racks and pinions, or other suitable machinery, worked on the vessel's decks, the attaching rods passing through water-tight tubes extending from the top side of the keel to the deck. The depth to which the sliding keel can be lowered, is of course limited by the depth of the main keel: being somewhat less, but its length being nearly that of the main keel, a sufficient area is presented to prevent that motion of the vessel technically termed "flatting off," which would otherwise take place under a side wind. The old-fashioned sliding-keel is objectionable, as the "well" or opening in which it slides runs fore and aft of the vessel, for one-fourth or one-third of her length, and requires the deck beams and frames for that length to be cut entirely through, thereby much diminishing the strength of the hull. Mr. Maskel's plan requires no such sacrifice; nothing is cut through; but the hull is built in the usual way, except the recess in main keel. For vessels navigating the shallow rivers and bays of our Southern coast it must prove valuable, particularly in the cotton districts, where the largest vessels of deep draft, unable to come in, are loaded by means of lighters. The plan is favorably reported on by a commission of United States Naval officers, and is approved by some of the most eminent naval architects of the country. Mr. Maskel has asked for an examination and report of its merits by the Committee of Science and Art, which may be looked for in the pages of the Journal.

BIBLIOGRAPHICAL NOTICES.

Manual of Coal and its Topography, illustrated by original drawings, chiefly of Facts in the Geology of the Appalachian Region of the United States of North America. By J. P. Lesley, Topographical Geologist. Philadelphia: J. B. Lippincott & Co., 1856. 18mo., pp. 224.

The unpretending title of this little work is very far from expressing either its scope or value. In place of a manual of one material, or of the rocks with which it is exclusively associated, we have here an admirable treatise on the geology of the older rocks of North America, as they lie developed on its eastern border, plainly written, and so far avoiding mere technicalities, as to be both intelligible and interesting to the general reader, while it is so accurate and logical in its statements, as to give it a very high value as a strictly scientific treatise. The point of view from which it is written is also not without novelty, being a happy mean between the dull, technical description of minerals and the rocks which they form, and the vague generalization of unsustained hypotheses with which we have been so annoyed in America.

The work itself is divided into four chapters; the first of which, "The General Relationships of Coal," contains an admirable account of this invaluable material, its various kinds and varieties, the manner of its occurrence, the rocks and minerals with which it is associated, the means of detecting its presence, and the peculiarities by which the same bed may be identified, when seen at different localities. This chapter, which includes within itself almost all that is promised in the title of the book, will be found very valuable to our coal-owners and proprietors, who are still too much in the habit of relying upon the experience of foreign miners and geologists, who lead astray by analogies which are true in their own countries, but false here, and advise expensive workings in unprofitable positions, while they pass unheeded valuable seams. Those who have a practical interest in these matters, will find in this chapter a succinct statement of the analogies and differences of our coal and that of Great Britain, and will be enabled, by carefully studying it, to form enlightened opinions on the capacities of those whom they may employ to survey for them.

The next chapter, or "The place of Coal among the Formations," is very interesting, giving a brief and clear account of the rocks in and above which the coal lies, and a comparison of the nomenclature of these rocks, as adopted by the various geologists. One of the great misfortunes arising from the mutual jealousies of the geologists who have conducted the separate State surveys has been, the giving different names to the same rock as it occurs in different states; and as is the almost uniform experience in such a case, the worst system of names is that which has been most widely adopted. Prof. H. Rogers, who from the early period at which he started the surveys of New Jersey and Pennsylvania, as well as from correspondence with his brother in Virginia, might have secured to himself the questionable honor of an early and imperfect system of nomenclature, judiciously, as we think, abstained from so doing, and contented himself with a temporary notation of the strata by numbers, so as to allow of the postponement of the final naming, until the extension of the system of State surveys had given us more knowledge of their nature and extent. His example has unfortunately not been followed by others, and a bad system of local names has been the result. The description of the coal beds themselves, given here by Mr. Lesley, will commend itself to all who have a practical interest in the subject, by its great minuteness and accuracy, and the care with which all available information of the subject has been digested.

The third and fourth chapters are the most novel, and will probably be found the most interesting to the general reader; they treat of topography first as a science, then as an art; and we do not know where we have seen so admirable a sketch of topography as is furnished here. We would strongly recommend the separate printing of this treatise, especially the third chapter, either by itself, or as an introduction to other rules on practical topography. We are sure that our readers will nowhere find in the English language so much valuable information on the nature and value of topography, its uses not only to the surveyor, but to every one who desires to gain a general and minute knowledge of any portion of country, its connexions with other sciences, and especially with geology, and the best manner in which its results may be presented to the eye, as are here to be found succinctly and clearly presented, and in a work whose title would not lead one to expect such a treatise.

In the course of the work, Mr. Lesley has more than once occasion to express his theoretical opinions as to the origin of certain geological phenomena, and he has done so in a manly and modest way, indicating the facts upon which he rests his arguments, and clearly stating his conclusions. These discussions will consequently be of interest, not only to those who agree with him in his views, but also to those who may more or less differ from him on certain points; for a clear and candid statement of an argument is an important step towards an agreement in conclusions. We hope soon to have to notice a second edition of this very modest and highly valuable book, and may then take occasion to develope our meaning more fully.

A Treatise on Land Surveying. By W. M. Gillespie, Civil Engineer. New York: D. Appleton & Co., 1856. 8vo. pp. 424. Tables 38.

The value of this excellent text-book is perhaps best shown by the statement, that it is the fourth edition of it which has been published since 1851. The work commences by a plain and illustrated statement of the methods of determining the position of a point, and then proceeds to explain the modes in which these different methods are applied in practice; commencing with the use of the simplest instruments, the chain or its substitutes alone, and proceeding to the more accurate, but, at the same time, more complicated processes which are in use. The drawing of the maps or plans is carefully attended to, and the modes of calculating contents well explained. Minute explanations of the method used in surveying the public lands in the United States is also given, which will be found valuable and interesting to our citizens generally. The subject of magnetic variation and its changes, (we wish Mr. Gillespie had given it its true name, "declination,") is also more fully explained than we have usually seen in such treatises, and the effects of these changes upon the apparent directions of lines of old surveys carefully pointed out.

The work ends with a number of necessary tables, of which the traverse table is in a new form, giving increased accuracy in much less space. The work bears marks of extensive research, scrupulous care, and judicious arrangement, and is very fully illustrated, and very well printed. The topography of the tables is especially worthy of commendation.

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FOR THE

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FEBRUARY, 1857.

CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

On the Improvement of the Ohio River. By Ellwood Morris, Civ. Eng.

(Continued from page 15.)

II. *Of the Plan of Dams and Locks, or Slackwater Navigation.*

From the data furnished by Mr. Ellet, in his prolific essays, we find that the descent of the Ohio River, exclusive of the 24 feet fall at Louisville, is precisely 400 feet between its head at Pittsburgh and its mouth at Cairo, a distance of 975 miles, or very nearly *an average of* 5 *inches descent to the mile.*

Now, if we suppose the low water surface at Pittsburgh to be raised 5 feet, we have a total of 405 feet *lift*, to be overcome by the successive dams and their locks, necessary to form a slackwater navigation throughout the length of the Ohio River, the Louisville Fall being already surmounted by locks and canals.

With dams lifting 8 feet each, 50 would be necessary.
do. 10 do. 40 do.
do. 15 do. 27 do.

Dams of 15 feet lift seem to have been preferred by some of the advocates of the Slackwater Plan, but no definite proposition upon this point has yet been made; for unlike the Reservoir Plan, the Lock and Dam Navigation appears to have no particular sponsor,* though it has been ably and rather favorably discussed by Herman Haupt, Esq., Civil Engineer, in a printed pamphlet, entitled "A Consideration of the Plans Proposed for the Improvement of the Ohio River: 1855."

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* See Appendix.

The objections to the plan of improving the Ohio River by means of locks and dams, are both numerous and weighty; they have been grouped by Mr. Ellet, in his usual brief and eloquent manner, in an article published in the Railroad Record of Cincinnati, which we annex to this communication.

There are however *four* of the leading objections to *the Slackwater Plan*, which appear to require more particular notice:

1. That it is not complete within itself, but requires reservoirs as auxiliaries, to enable it to operate with success.
2. That it will cause the river to be much more frequently and longer obstructed by ice, and will render heavy ice freshets both more frequent and more dangerous.
3. That it will increase materially the height of the floods, and injure or destroy a vast amount of private property.
4. That it will be exceedingly costly in its first construction, and after maintenance and operation.

Referring now to these leading points in succession:

1. The experience of the Monongahela navigation shows conclusively the necessity of reservoirs to maintain in dry weather the requisite depth of water in their pools; while Mr. Haupt, in the pamphlet referred to, considers them indispensable to the success, not only of the Slackwater Plan, but of others which he discusses; happily, reservoirs are essential to all the plans that merit examination, and form a common ground on which the advocates of each plan meet.

2. It is well known to those familiar with the Ohio River, that the chief part of the floating ice which first obstructs the navigation, and afterwards closes it by freezing together, comes from the Allegheny; and as the river even now, notwithstanding its continuous current, remains closed some fifteen or twenty days, in every ordinarily hard winter, accompanied by low water, it can hardly be doubted, that if the ice which is incessantly floating down the Allegheny, from the very commencement of cold weather, were received in slackwater pools, (usually low in the cold season, and without much current,) the river would close earlier, open later, and would doubtless remain embargoed by ice, *about two months in a winter.*

Again, this floating ice of the early winter, accumulating gradually in the pools, being carried in fragments from one to another, while in thin cakes, would eventually, as the weather grew colder, freeze therein into a continuous mass of great thickness and solidity; while prior to the breaking up of the more gentle Ohio, the rapid Allegheny would force large quantities of ice into the upper pool, and effectually blockade the port of Pittsburgh; finally, this vast accumulated mass of heavy ice would be torn from its bed in the pools by the first high freshet, and hurled along the valley of the Ohio with a terrible effect, such as has not yet been witnessed, and can hardly be appreciated upon that river.

3. In order to show conclusively that the construction of dams in the Ohio River could not fail to augment the height of floods above the

surface line they would take, if unobstructed by the dams, we refer to the sketch, (Plate II., fig. 5,) showing the actual top-water line of a freshet on the Potomac River, in its passage through the pool of dam No. 5 of the Chesapeake and Ohio Canal, (June 1st, 1836,) obtained at the time from actual levels procured by the writer and his brother engineers, (Joshua Gore and John A. Byers, Esqs., all of us being then engaged in the construction of contiguous divisions of the Chesapeake and Ohio Canal;) through the aid of these gentlemen, simultaneous levels were taken on a line of over 30 miles of the Potomac River, at the time of its maximum rise; Mr. Gore furnishing the levels upon the pool of dam No. 5, which was on his division, while Mr. Byers and the writer continued them up as far as the mouth of the Great Cacapon River, a distance in all of about 32 miles.

This profile of a great river in flood, showing the modification of its surface line produced by a dam of the same altitude as the freshet assumed beyond its influence, that is to say, 18 feet, speaks for itself; and it shows more clearly than any calculation, and with a positive certainty, that by the establishment of similar dams in the Ohio, we must expect, as a necessary consequence, to augment the height of the Ohio River floods, *at least from five to ten feet;* and with the impeded discharge these dams would have in a slackwater navigation, from the others necessarily backing their water against them, there is a strong probability that the augmentation of the floods *would be even greater.*

But no such augmentation is admissible upon the flood waters of the Ohio River, and none such, it is certain, will ever be allowed by the people resident upon its borders, to be produced by obstructions placed in the channel; and this inevitable result alone is adequate to defeat the Slackwater Plan, since happily no power exists either inclined to plan, or able to carry out, such wholesale devastation of private property as would be inseparable from this unwise measure.

It is true, that by reducing the heights of the dams, and largely increasing their number, the injurious effect of these obstructions may be mitigated to some extent, but cannot be removed, except by removing the dams themselves; whilst the great multiplication of the dams, *if low in lift*, would then become a serious evil; for each of these structures will produce certain inevitable delays and difficulties, which, on the whole, would be proportional to their number, and form a serious aggregate.

If it were possible to elongate materially the available breadth of the overfall of the dams, some mitigation of the augmented raise upon the floods might probably be hoped for; but, it is well known, that the Ohio is too uniform in its section to admit of this, except as a specialty, and that it is the river hills alone which at present bound its high water flow. Now, wherever a dam should be erected, heavy guard banks for its preservation would have to be extended to the adjacent hills, and thus cut off a large part of the high water section, now made available by the river, when out of bank, in spreading to the feet of the hills bounding its immediate ravine; and, consequently, the very guard banks necessary to secure the dams on this peculiar river, by reducing the flood water section, and forcing the whole flow channel-wise, would thus again increase its height in flood, and tend to overcome the benefit of an elongated dam.

But, in point of fact, unless in a few exceptional cases, the transverse breadth necessary to be occupied by the double locks, their guard walls, and the abutments of the dams themselves, would be so considerable—*no less than* 250 *feet*—that, so far from being able to realize an elongated overfall, *the usual case, would be an unduly contracted one.* A remarkable point in the experience of the Monongahela navigation, verifies our Freshet Profile (Fig. 5), in a satisfactory manner, and shows its applicability to these rivers; it is this, that whenever the depth of a freshet on the combs of the Monongahela dams is equal to their lift, (8 feet,) they are always safely passed by steamboats, without using the locks, the dams being fairly drowned out. Now our profile (Fig. 5), shows, that about the point near the head of the pool, where another dam would have been placed to continue a slackwater navigation, the depth from the freshet line to the low water level of the pool is 19 feet, *or just double the depth on the comb.*

Hence we may probably generalize, thus far at least, *that with a series of equal dams of about ten feet lift succeeding each other, in a slackwater navigation upon a river of uniform section, the freshet depth on the comb of one is just half the backwater raise above that level, at the foot of the next;* consequently, whenever the freshet depths of water upon the combs equals the low water lift of the dams, the top water surface of such freshet will present a continuous inclination, or the dams will be drowned out, and passable by boats.

This is confirmed (both by our profile upon one river falling two and a-half feet per mile, and by the experience of the Monongahela navigation upon another, with a descent of only 10 inches to the mile), with sufficient closeness for the practical purposes in hand, though the writer is not yet able to say that the law is general.

From the above discussion, another practical consequence flows, that whenever in a slackwater navigation the freshets have a magnitude adequate to drown out the dams, and thus enable boats to pass them by the channel, without using the locks, *the working guards of those locks should equal the low water lift of the dams:* in which case the locks could be used until the depth of water over the dams equalled their lift, when becoming drowned, the boats without loss of time would continue the navigation by the channel, disregarding the dams, and resume in like manner the use of the locks, so soon as the falling water reached a comb depth upon the dams equal to their lift.

But it seems useless to argue this question further; there cannot be a doubt that obstructing the channel of the Ohio River, by the dams of a slackwater navigation, will materially elevate the freshets, while there are many well known cities, towns, and villages, and much other valuable property *within* the scope of the present high-water line, along the borders of this stream, *which cannot stand any addition* to the height of those fearful floods without loss and damage too serious to contemplate.

It may not be inappropriate to state in this connexion, that a few years since, during the prevalence of a considerable freshet, the writer came to the summit of the Ohio River Hill, behind the town of Pomeroy, then partially submerged, and witnessed the passage down the channel of the well known Steamer *Buckeye State;* the swell created by the boat, immediately floated off their foundations several houses, which had been supposed to be securely fastened by means of ropes. Now had there been a dam below that town, forming (as proposed,) a fine slackwater pool in front of it, that pool raising the freshet water 5 or 10 feet more at that time, *would have almost ruined the place it was intended to benefit and beautify.*

The reflecting reader at this point in the case, might well put the question,—why not control the floods by reservoirs, and use the slackwater also?

The answer to this is brief and decisive: *Reservoirs of a magnitude necessary to control the floods with certainty, are adequate of themselves to maintain the navigation, and render locks and dams unnecessary.**

4. The dams and double locks that would be provided for the Ohio River navigation, were the slackwater plan adopted, ought (it will be admitted), to be constructed in the very best and most substantial manner.

It is an important and most unfavorable fact, that the great works necessary to form a slackwater navigation, worthy of this river and its business, will in almost every instance *have to be founded upon sand or gravel*, as there are few, if any sites where a continuous rock from shore to shore, can be found at a moderate depth in the bed of the Ohio.

While making reasonable allowance for the anticipated difficulties, it is evident that no precise calculations can be made in advance of actual surveys and special plans; nevertheless, the writer has felt emboldened by his long experience upon canals and rivers, to make some rough estimates upon this subject, and thinks he hazards little in the assertion that the probable cost of a substantial slackwater navigation from Pittsburgh to Cairo, 975 miles (excepting the falls), would amount to not less than *twenty-five millions of dollars;* and Mr. Ellet, whose experience upon canals and rivers has been very extensive, has reached the same conclusion. If to this we add the auxiliary reservoirs, deemed necessary to control the floods, the aggregate would not fall short of *thirty-five millions of dollars!*

Even this great sum will not appear large to those Civil Engineers who reflect that such works as would be necessary to control this mighty river—constructed upon the dangerous gravel bottom which forms its usual bed—have never yet been executed in any country.

To bridle, by means of locks and dams, a river, which in its maximum flood rises 31 feet at Pittsburgh, 44 feet at Wheeling, and 63 feet vertical at Cincinnati; upon loose gravel bottom to erect guard walls to out-top such floods, and locks and dams adequate to withstand their fury, aggravated as it will be by vast masses of ice prepared each winter in the pools themselves, is a problem in engineering, the like of which has never yet been solved in any part of the world.

*See page 20 of Mr. Haupt's pamphlet, wherein he proves that reservoirs adequate to have maintained a 6 feet navigation, would have been insufficient to control the floods of the year 1848! And yet proposes reservoirs as *auxiliary* to slackwater, while demonstrating their ability *of themselves*, to have kept the navigation up!

But suppose the work *done*, it would then become indispensable to the prompt dispatch of the great business contemplated to provide and keep in readiness one or more steam-tugs at every lock; to facilitate the passage of huge and clumsy rafts of lumber from the Allegheny—unmanageable coal boats from the Monongahela—or vessels disabled in the vicinity. These added to the necessary attendance at the lock-gates by day and night, the maintenance of lights, the reparation of accidental damages, and the support of the ordinary wear and tear of works of such magnitude, would undoubtedly form a serious annual sum, which it is hardly necessary to speculate upon. Suffice it to say, that (whether added to the interest on the cost of construction or not,) if these annual charges were levied in the shape of tolls at the locks, they would form a grievous burden upon all the business, and could not fail to be utterly destructive of that great coal and lumber trade, which is now so important to Pittsburgh and its vicinity, and to the northern Counties of Pennsylvania.*

We will now annex the able review of the Slackwater Plan, contained in the letter of Charles Ellet, Jr., Esq., Civil Engineer, addressed to Prof. E. D. Mansfield, of Cincinnati, a gentleman of well known scientific attainments, resident for many years upon the banks of the Ohio, and certainly as capable as any one can be of appreciating this great question. That Mr. Ellet's views have secured his approbation, is a matter of importance; because that approbation is of consequence, in the Western States.

Improvement of the Ohio.† By Charles Ellet, Jr., C. E.

Burnet House,
Cincinnati, April 30, 1856.

Two plans are proposed for the improvement of the navigation of the Ohio River.

The first of these is my own proposition, to form reservoirs on the tributaries of the river, in which water will be collected when the drainage of the country is in excess, and from which the channel will be supplied when the navigation fails, in times of drought.

The other is the plan of locks and dams—the advocates of which propose to construct about fifty dams across the river, to increase the depth of the water, and to place two locks in each dam, to overcome the obstructions created by the dams themselves.

I have recommended the formation of reservoirs on the tributaries of the river, and objected to the construction of these dams across the channel of the river, for the following reasons:

I. After the dams shall have been constructed across the Ohio, it will be found that *they cannot be made water-tight.* The dams will leak, and reservoirs on the tributary streams will be needed in the summer

* It has been generally supposed that reservoirs built upon the main affluents of the Ohio, would necessarily put an end to the lumber business; but such is far from the fact; they can easily be arranged, so as not only to accommodate, *but greatly to facilitate this valuable trade.*

† From the Railroad Record, Cincinnati, Ohio.

season, to supply the pools themselves with sufficient water to float the boats.

This point is illustrated by the slackwater navigation on the Schuylkill River, where *three reservoirs* are now required, and are resorted to annually, to supply water to compensate for the losses resulting from the evaporation, and from the leakage and lockage at the dams.

It is illustrated, also, by many other slackwater improvements; but more particularly by that of the Monongahela River, where, during *the greater part of the summer and fall of* 1854, the water not only ceased to run over the dams, but, by evaporation and leakage, *was almost literally dried out of the pools.*

The Monongahela Company now contemplate resorting to "immense reservoirs," from which a supply can be drawn, in seasons of low water, into their lower pools, and thus keep them in good navigable condition.

They now have a lock and dam improvement, but find that they still need *reservoirs* to supply that improvement with water, and make the dams useful.

Instead of building dams to obstruct the navigation of the Ohio, and locks to overcome the artificial obstructions occasioned by the dams, and reservoirs in the mountains, from which to supply the pools with water, I propose to form the reservoirs in the first instance, and to supply the river itself from them at once, and dispense entirely with the locks and dams. It will require much less water to supply the river in its natural condition, than will be needed to supply it after its channel has been obstructed by leaky dams, and a wider surface has been exposed to the sun and air, and the evaporation thereby increased.

II. *Locks and dams will set a limit to the amount of freight which can be transported on the river.* The plan which I propose—that of supplying the river with water in times of drought—will leave its capacity for conveying freight, for all practical purposes, absolutely unlimited.

After these dams have been built, the number of boats which may traverse the river will no longer be determined by the quantities of produce, minerals, or lumber, that the region of which the Ohio is the great highway, is capable of producing, or which its markets may demand, but *they will be limited to the number that may be passed through the locks.*

The inability of double locks to pass the trade of the Ohio, is fully demonstrated by the Monongahela navigation, where the coal-boats occasionally crowd by *hundreds* to the locks; and, in the haste and anxiety to get through, block up the approaches against all ascending craft, for several days in succession.

There are only five or six steamboats plying on the Monongahela, and requiring the use of its locks; but the improvement of the Ohio, to be tolerated, must be such as may by relied on to accommodate not only the present and prospective coal trade of the Monongahela, but also the lumber trade of the Allegheny; the iron and miscellaneous trade of Pittsburgh; several hundred Ohio River steamboats, and the proper trade of the Ohio River itself. This vast aggregate could not be passed through double locks, even if a set of double locks could always be kept in good working order.

But we cannot hope to have two locks at each of the fifty dams—exposed as they must be to injury from boats and from floods—always in order, unless we provide at least *three locks* in each dam.

III. The delays at the locks will be greater than the running time now required to make the trip; and, consequently, the time now required for every ordinary voyage will be *more than doubled* by the detention at the dams.

If reservoirs are adopted, and water supplied by them to the channel, when it is needed there, the time required to make the trip will be reduced.

IV. If dams are placed across the channel of the Ohio, all the trade of the river, for not less than fifty weeks in every year, will be forced through the locks.

Careful and recorded observations, made at Wheeling, for twelve years in succession, show that the water would not be high enough for boats to go safely over the dams, on an average, fourteen days in the year.

V. If the navigation is improved by reservoirs, no interest can possibly be injured thereby. If the channel is obstructed by dams, the rafting business will be completely destroyed.

VI. Dams on the Ohio, however skilfully they may be planned by the engineer, and however faithfully built by the contractors, will sometimes prove to be imperfect. Resting often on treacherous foundations, some of them will be injured by the ice, and some will be undermined by the floods. This has been the experience wherever numerous dams have been built on the same stream. Such misfortunes have occurred on the Lehigh, on the Schuylkill, on the Potomac, on James River, and on the Monongahela. They may occur also on the Ohio.

When one of the well built dams on the Monongahela gave way, in 1842, the bottom of the river was washed out to a depth of 40 feet. One year was lost in consequence of the continued high water, and when in the second year after the breach was formed, the water fell so that the work of reparation could be commenced, it required *four months* for the most skilful and energetic men to close the gap and secure the dam.

What, I ask, would be the condition of things if one of the fifty dams which it is so lightly proposed to construct on the Ohio, should be washed away, or undermined, and the navigation there suspended for four months?

If we resort to reservoirs for the improvement of the navigation, no damage can result to the trade of the Ohio from a derangement or breach of any part of the works.

VII. Dams will obstruct the navigation, and cause the boats to crowd and jam against the entrance of the locks. These boats will sometimes be sunk—as has happened on the Monongahela improvement, and indeed on every canal in the country—and stop the navigation until they can be removed. A pair of coal-boats will contain a thousand tons, or more; and the removal of so great a mass, from under water, will be a slow and tedious job.

If the river is fed from reservoirs, the channel will be kept always clear, and there can consequently be no jamming of boats. If a boat sinks, there will be room in the channel for other boats to pass by it.

VIII. If locks and dams are adopted, steamboats will sometimes be driven carelessly against the works, and stave in the gates. This occurs frequently on canals, and has occurred on the Monongahela, though but few steamboats run there. In this one instance, a new pair of gates happened to be ready, and the navigation was restored, by the great skill and energy of the President of the Company, in four days.

If the navigation of the Ohio should be stopped for only *four days*, some seventy or eighty steamboats would collect above and below the locks, and, at some seasons of the year, in that space of time, from 500 to 1000 coal-boats, flat-boats, and rafts, in addition to the steamers, would be arrested there.

The collection, in the space of only a few days, would sometimes be so great on that river, that its whole channel would be filled entirely across, from bank to bank, to the distance of two or three, and, at times, even to the distance of five miles from the locks. On the canals of this country, we have often witnessed such sights, on a smaller scale. In one instance, *seven miles of canal boats* blocked up the entire breadth of the Erie Canal, before the breach which stopped their progress could be repaired. But the boats and locks of a canal are of manageable dimensions, and nearly three hundred boats can be let through a well appointed lock in a day. A pair of coal boats, or a raft, would occupy the huge locks which will be required to pass the Ohio River steamboats, more than an hour. It is indeed very doubtful whether a raft which would fill one of these locks, and cover therefore more than half an acre of surface, could be let through and got out of the way in less than *three hours*. But, assuming that the average time for a pair of coal boats or a raft, would be an hour, to pass five hundred of them through a single lock, working day and night, would consume at least *ten days*, and during that ten days, at certain seasons of the year, as many more would approach and struggle to get through, as the way might be cleared for them. Small, comparatively, as is the present trade of the Monongahela, and rapidly as the smaller locks there required can be worked, the descending coal flats frequently shut off the navigation for ascending steamers on that river, for three or four days in succession.

IX. The cost of the fifty dams and one hundred locks which it is proposed to build on the Ohio, deduced from the ascertained cost of the Monongahela Improvement, with a proper allowance for the increased length of the dams, the increased length, width and height of the locks, and the increased value of labor and materials since that work was completed, twelve years ago, would be about *twenty-five millions of dollars*.

The cost of procuring a five feet navigation by means of *reservoirs* on the tributaries, ought not to exceed *two millions* of dollars.

Is it better to expend twenty-five millions and obstruct the channel of the Ohio by fifty dams, during nine months of the year, when the navigation is perfect, or to pay *two millions* to remove the obstructions caused by low water during three months of drought?

X. Almost every city on the Ohio is built in part on soil subject to be overflowed. The construction of dams below these cities will increase the heights of the floods, and the depths and the frequency of the overflows.

Dams in the mountains may be placed where no valuable property will be covered by the reservoirs, and they cannot fail, by retaining a portion of the surplus water, to reduce, instead of increasing, the height and destructive power of the floods on the river.

XI. Dams across the Ohio will set the water up into the mouths of all the tributaries, great and small, which empty into its channel. On these tributaries are valuable mills and mill privileges, which will be submerged, even in low water, and destroyed by the dams.

The reservoirs in the mountains will destroy no mills or water power, but, on the contrary, they will create vast and never failing water power wherever the dams which form the reservoirs are placed.

XII. The advocates of locks and dams cannot be opposed to reservoirs, nor deny the practicability of obtaining water enough by that means to feed the Ohio. They cannot take this ground, for every dam they propose to build will form a reservoir of immense size, but one which is not available, because it is in the wrong place. The fifty dams which they propose to raise on the Ohio, will form reservoirs in the river itself, covering, in the aggregate, a space of over *four hundred square miles*, and holding three times as much water as would be needed, if they were placed where they ought to be, in the mountains, to afford a five feet navigation the year round, from Pittsburgh to Cairo.

To avoid forming reservoirs in the mountains, where they will do great good, they propose to make pools in the river, where they will do great harm. These pools in the river will contain fully three times as much water as need be discharged from the mountains to support the navigation throughout the summer. And, after the pools are made in the river, and the navigation has been destroyed by the dams that form them, great reservoirs in the mountains will still be required to supply these pools with water.

Is it not better, I ask, to make the reservoirs in the mountains at once, and dispense with the pools in the river altogether?

XIII. The dams which it is proposed to construct on the Ohio, will convert the channel of that river into fifty stagnant and pestilential ponds, endangering the healthfulness and diminishing the population of its valley.

High dams in the mountains will form deep lakes in the rock-bound gorges. These lakes will be filled with cool water in the winter and spring. This water will retain its coolness until it is needed for the navigation, and then gush forth in refreshing torrents, which will temper the heats of midsummer on the immediate borders of the river.

The locks and dams will destroy the navigation of the river when it is in the best condition, and impair the healthfulness of its shores when they are the least salubrious.

The reservoirs in the mountains will improve the navigation when it most needs improvement, give motion to the river when its waters are stagnant, supply the cities on its banks with a more wholesome beverage, and wash out, as far as fresh water can do that work, the causes of malaria.

I object, therefore, to locks and dams on the Ohio. I object to them, because the river can be improved by a plan which will leave its channel unimpaired and unobstructed; which will improve the navigation of its tributaries, while it improves that of the river itself; which will tend to diminish the height and destruction produced by the floods, while it increases the depth of the channel in seasons of drought. Which will create immense water power in the mountains, without destroying the water power near the river. Which will pour a healthful current of cool water into the channel from the reservoirs in the mountains, instead of converting its living stream into putrid pools. Which can be used to carry away the ice that obstructs the navigation in the winter, while it overcomes the effect of drought in the summer. Which will improve the health, while it increases the wealth of the country. Which will do some good to every interest, and injure none.

This is the plan which I offer as a substitute for locks and dams on the Ohio.

It is not a speculative plan. It is based on careful measurements of the volume of water flowing down the Ohio, day by day, and every day, for a period of six years. It is the conclusion which results from minute, laborious and appropriate investigations.

This plan, and the facts on which it rests, have been given to the public in a work which has received the approbation and concurrence of scientific minds throughout the country.*

Is it not, then, worthy the attention of that great community of business men which has put the locomotive in motion on the mountain tops, and filled the navigable rivers of the West with magnificent steamers?

I have done my share of the work. I have projected the plan. I have measured the discharge of the river. I have demonstrated the practicability of the scheme, without aid or encouragement, and I ask now only that they who are to be the most benefited by the work shall assist in its execution.

Remarks by Prof. E. D. Mansfield, Editor of the Railroad Record, Cincinnati.

Instead of any elaborate article of our own, we are pleased to give our readers one more valuable, in the foregoing discussion of the Improvement of the Ohio River, by Mr. Charles Ellet, Civil Engineer.

In an early number of *The Record*, we noticed at some length the very able work of Mr. Ellet on the Mississippi and Ohio Rivers. It was one of those accurate and enlightened investigations of a difficult problem in physics, which only an able and well instructed man of science could make. All the *elements* of the Ohio River, such as the quantity, depth, and distribution of water, necessary to the solution of the problem, were carefully ascertained; and the results commended themselves to our mind with the precision and certainty of truth. We thought then, and do now, that Mr. Ellet's plan was not only practical and cheap, but was the only one which promised success. With this conviction, we lay before our readers Mr. Ellet's interesting communication.—*Ed. Rec.*

* See Ellet on the Mississippi and Ohio Rivers.

(To be Continued.)

On the Mathematical Theory of the Stability of Earthwork and Masonry.[*]

By W. J. Macquorn Rankine, Esq., C. E., F. R. S.

In the preparation of my course of lectures, I have found it necessary to re-investigate much of the above named branch of mechanics, and I have now a paper in preparation on the subject, which I propose to offer to the Royal Society when it is ready. In the meanwhile, it appears to me that the two fundamental principles on which my researches are based are of such a nature, that they may very properly be communicated to the Royal Society at once. They are as follows:—

I. *Principle of the Stability of Earth.*

At each point in a mass of earth, the directions of greatest and least compressive stress are at right angles to each other; and the condition of stability is, that at each point the ratio of the difference of those stresses to their sum shall not exceed the sine of the angle of natural slope of the earth.

II. *Principle of the Transformation of Structures.*

Let a structure of a given uniform transverse section be stable under a system of forces represented by given lines in the plane of section:—

Fig. 1.

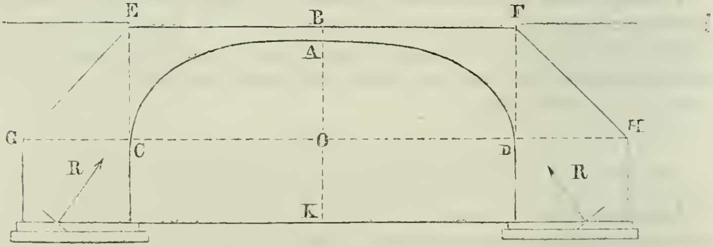
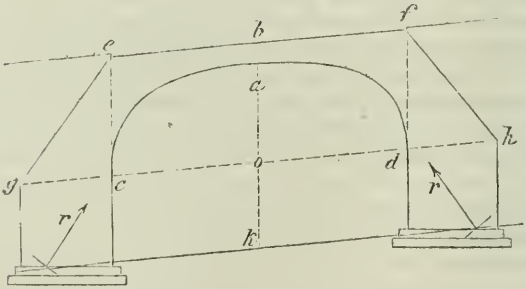


Fig. 2.



Then will any other structure whose transverse section is a *projection by parallel lines* of that of the first structure upon any other plane, be stable under the system of forces, represented by the projections, upon the new plane, of the lines representing the first system of forces.

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[*] From the Lond., Edin., and Dub. Mag., December, 1856.

Example of the Application of this Principle.

Let fig. 1 be an equilibrated arch with its abutments of the form (for example) proposed by M. Yvon-Villarceaux, suited for a horizontal extrados EF. OK, OA, and AB being given, all the dimensions of the arch and abutments are functions of those three quantities.

It is required to design an arch, fig. 2, for an extrados *e f*, at any given inclination, of any given span *cd* (measured parallel to the extrados), and in which *ok* = OK, *oa* = OA, and *ab* = AB, are the same as in the primitive arch, fig. 1.

Solution. On any vertical plane passing through BK, and not coinciding with the plane of fig. 1, draw *cod* of the given length and inclination, intersecting COD in O. Join C*c*, D*d*, and project the whole of fig. 1 on the new plane by lines parallel to C*c*, D*d*. The projection so obtained will be the figure of the arch and abutments required. Moreover, if the lines R, R, fig. 1, represent in length, direction, and position, the resultants of the pressures of the abutments on their foundations in the original arch, then will *r*, *r*, fig. 2, the projections R, R, represent the corresponding resultants in the new arch; and in like manner, the thrust at *a*, is the projection of the thrust at A.

Glasgow, February 18th, 1856.

NOTE. The horizontal foundation courses in fig. 2, do not form part of the projection of fig. 1, but are supposed to be added after the completion of the projection.

For the Journal of the Franklin Institute.

On the proper mode of Constructing an Ice Boat. By A. C. JONES.

Access to and from the Ocean during the winter season being admitted as important to the interests of the Port of Philadelphia, I purpose making some remarks on what has been done, and offering some suggestions for improvement in the mode of keeping open the channel when obstructed by ice.

In 1837, the City had built for that purpose a steam ice-boat, the model of which unfortunately lacked every essential feature fitting it for an ice breaker; no excuse can be pleaded for this mistake, as several years before, the City of Baltimore had an ice boat *in use* which was far better adapted to the breaking of ice; and again, those having its construction must have seen the wherry-boats, which in the winter season were the only means of getting across the river, and noticed the fine form of the bows of those small boats for that purpose: but these guides were unheeded, and the *butting* principle was carried out: that this boat was a failure, no unprejudiced person having witnessed its floundering in the ice will gainsay. Having been some thirteen winters absent, I am not personally cognizant of what the "Philadelphia Ice Boat" did during that time, but last winter after the navigation was closed, and the increased temperature had begun to prepare the way for an open channel, I was attracted to the river at a time when a large steamboat was *very* slowly making her way through the floating ice. I soon found out by the letters on a large sign that this was the "City Ice Boat," and yet with all these years of experience, the bow unfitted as it was in 1837, remained the same in 1856.* The only marked change I noticed, was, that some ingenious person had with innumerable stays and braces, tried how near to a drum a paddle wheel could be made, and yet retain any propelling powers. "O! but this was done to save the wheel;" admitted; but if the wheel could have been made strong enough, what will become of the shaft and crank? Now, sound engineering could have made the wheels of sufficient strength without impairing their propelling powers, and have prevented them and the shafts or cranks from breakage, (which always happens in the most inopportune time,) by the use of *friction couplings*, so that when the arms met with too much resistance, the wheels might be prevented from breaking by the slipping of the coupling.

I have alluded to the ice boat of Chesapeake Bay. Its bow was formed like the bowl of a table spoon. In 1834 I was aboard of that boat when breaking its way up to Baltimore. The modus operandi was to give headway to the hull, and when the bow struck the edge of the ice, a portion was crumbled down until the slow displacement of the water under the ice caused the bow to rise and run up on the surface, where it would rest for a short time; the weight of the boat finally breaking its way through, the boat was then backed, and the same process repeated.

In this boat the error was in making the curves of the bow too flat, thereby causing a great displacement of the water under the ice, which had principally to flow under the hull before the cohesion of the ice was destroyed. A sharp straight stem, at an angle of about 20°, its cross section of a V shape, would have been much more effective.

At Ports on the Baltic, channels have been frequently sawed out to allow a fleet of vessels to get to sea; this plan, substituting the "ice plough" for the saw, has also been tried in the United States.

Running on the ice and breaking it down; and the Philadelphia plan of *forcing* the way stem on by main strength, are the only methods I am aware of. It has surprised me, that where so much is at stake, experiments with different feasible principles had not been instituted years ago.†

As I know of no direct experiments in ice breaking, I will give from memory some on a small scale made by me twenty-eight years ago. One day watching a farmer ploughing, it struck me that that was the true principle for breaking a channel in the river (having then some connexion with the mercantile interest, I was years before impressed with the importance of keeping the river open during the winter). As soon as it was cold enough I made a series of experiments, (some proved of no practical value,) to test the best way of breaking ice. I carefully sawed out a circular hole in the thin ice covering the water in a tub, and over the whole I placed a narrow piece of board some inches longer than the diameter of the opening. On this board I gently put weights, until the surface of the ice became "dished," but not cracked; the weights were then removed; and through a small hole in the centre of the board a cord was passed and its end fastened; the board was then put under the ice so as to have the same position as it had before on the top surface, and the cord was attached to the end of a balance lever of the first order, (its arms being of equal length,) the fulcrum being on the edge of the tub, the same weights were hung to the end of the lever as had been placed on the board; before all these weights had been used the board tore up the ice some distance from the hole.

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* I have understood that the bow has been slightly altered since that time. This must be an improvement, for no change could make it worse than it was before.

† I fear that Philadelphia, instead of being foremost, is content to stand still, wearing faded laurels obtained long since; for at the present time, I hear the same *talk* about burning anthracite coal in locomotive boilers, and the *twaddle* against the railroads in the City, &c., that was common some twenty years ago.

Next, I made small model boats, the bow of No. 1 having *a vertical stem;* No. 2 *slanting* something like the Baltimore boat; and No. 3, had a bow approximating to a right and left plough placed "land" to "land," the point of the share being below the skim ice; all of these models have the same beam. To the bow was attached a string, each passing horizontally over a pulley placed at a distance, so that the angle would not affect the result, as might have been expected. No. 1 required the most weight to force it through the ice; No. 2 requiring less, and No. 3 taking the *least weight of all.* These experiments were repeated several times without changing the result, and they satisfied my mind that the ploughing or *rooting* principle was the best; but as it may be said, that these trials were on too small a scale to settle a principle, they could be verified, by taking canal boats and having temporary bows fitted to them. Ice of a proper thickness, for an experiment, could always be obtained, by removing a portion of the ice if too thick from a canal, or still water, and allowing new ice to form; a dynamometer would decide the merits of each plan. I have noticed that in ice-breaking with boats, only one method was pursued, whether the ice wassolid from shore to shore, or in floating masses, and if the former, they could only work favorably against the tide on account of the fragments clogging the wheels, thus losing much time when the tide did not suit, and also having the current to stem, which reduced the effective power of the boat.

When steamboats have to ascend rapids, or swift running streams, they do not depend altogether on the paddle wheels, for if they did, it would be *one foot ahead, and two back*, but a line is run out ahead and made fast, and the boat is "warped" along until the difficulty is overcome; so it should be in channel breaking, and this auxiliary could have easily been brought into use last winter if either of the ice boats' bows had been different.

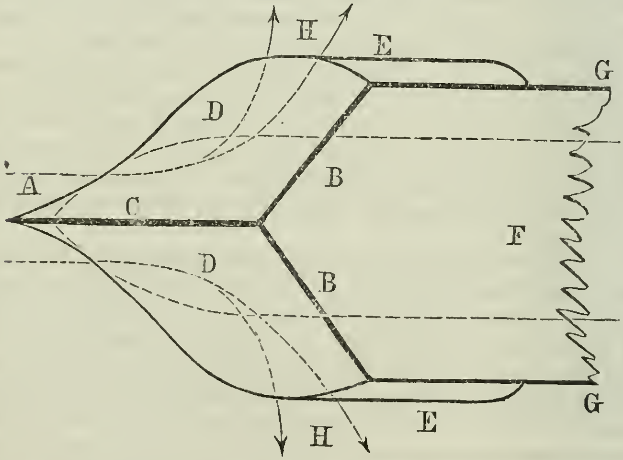
If the "rooting" principle is carried out, of course the point or toe of the plough should be at the stem so far below the water line (and the boat should be trimmed by the stern,) as to pass under the ice, and the wings or mould boards should extend out a little beyond the line of the guards, (if side wheels are used:) on the deck there should be strong bulkheads placed at angles, the apex ahead; these shields should flare forwards and outwards, so as to prevent any ice from coming on deck, their angles acting in conjunction with the inclined surfaces of the "mould boards."

To facilitate the management of the boat, a central portion of the hurricane-deck could be extended to the bow clear of all below it.

Now, when this bow is run up against the solid ice, its first action would be to rip it up on the central ridge, and the mass on each side would be forced up, the curved surfaces breaking into cakes, these passing off sidewise, and the impetus given would cause them to slide over the solid ice far enough from the channel to give no further trouble. On this principle the boat could work best with the tide, as the broken ice would be kept out of the way of the wheels or screw. But a better way to ensure a steady progress when the ice was thick and solid, would be to have a gang of men (pioneers), with a light sled, having on it a reel of "warping line," one end on the boat, the sled being run ahead, and the line payed out to its end, which is to be secured to hooks placed in holes cut in the ice; the boat is now to be forced ahead by the warp and the paddle wheels, which, as I before observed, should be attached to the engine by *friction couplings;* as the rope came in, it could be wound on another reel, so that when the hooks broke out, all could be hoisted out by a derrick, and placed on the bearings of the sled to be run ahead as before. When the ice was floating the propelling power would be sufficient; in fact, a properly constructed boat could run to and from salt water, fast enough to keep an open channel, (and this should be its only duty in winter, leaving towing to private enterprise,) as ice in a running stream does not form many inches thick in a day.

If this principle was carried out more fully in bridge piers, we should not hear of so many of them being carried away or injured every spring. I would advise skeptics, or those opposed to this principle, to visit Trenton Bridge at the breaking up of the ice, and there view its action, and they will see that the ice runs up the piers, breaks into fragments, falls and slides on the tops of the large masses passing unbroken between the piers, to be carried away on them.

As all are familiar with the form of a plough, the annexed diagram of a top view of the bow will make it intelligible.



A the stem; B B bulkheads; C the curved inclined cutting or breaking ridge; D D curved inclined surfaces corresponding to the "mould board" of a plough; E E bearers, solid with the boat's guards, but outside of them; their under surfaces formed like a "shoe" or broad runner, should be about 18 inches above the water line, so that when "*rooting up*" thick ice, these bearers would slide on the surface of the solid ice or break its edge down; F the hull; G G the boat's guards; H H pointers, showing the direction of the fragments of ice as they slip off the inclines sidewise into the surface of the solid ice.

P. S. Since writing this communication, I have seen the model and a description in this *Journal*, of an ice boat, patented by H. & W. Brown. It does not materially differ from the plan I suggest, except in having side *guards*, and causing the broken ice to be passed *under* the solid ice on each side. I think that in practice these "*guards*" will be found to be an incumbrance, instead of a benefit, and also, that the same impulse given to a cake of ice will cause it slide *over* the surface to a distance many times greater, than the resistance of the water would allow it to go under the surface of the solid ice.

AMERICAN PATENTS.

List of American Patents which issued from December 9th, 1856, *to January 6th,* 1857, (*inclusive,*) *with Exemplifications.*

DECEMBER 9.

32. For an *Improved Machine for Feeding Paper to Printing Presses;* David Baldwin, Godwinville, New Jersey.

Claim.—"The method of feeding paper or other flexible material to printing presses, and other machines, which require the feed of a single sheet at a time, or separate feed of the sheets from a pile or number of sheets, by giving to or forming the sheet or sheets, with a lap or fold, or folds, and establishing the feed of said sheets, by means of a drawing or spreading out bar, or its equivalent, acting within or against the fold or folds of the sheets, to effect the separation and extension with certainty and despatch. Also, the employment of 'lap folded' paper, or other material, in sheets in such machine, when the fold or folds are made the means, by any suitable mechanical appliances, of effecting the ready separation and feed of the sheets. Also, when combined for operation together with an automatic feed of the lap folded sheets, a lap folding apparatus to fold the sheet after its delivery from the first feed or passage through the machine, for a second passage therethrough, by said feed acting against the fold or lap."

33. For an *Improvement in Sail-hanks;* Henry M. Bonney, New Bedford, Mass.

Claim.—"The arrangement of the hinge and the guard, relatively to the eye and the clasp, or connecting contrivance; the entire guard being in one piece, and fastened to the movable part of the body, and so as to be movable with it, and to open from and shut against the other part."

34. For an *Improved Alloy Composition;* Timothy Brown, Georgetown, N. Y.

Claim.—"The metallic composition or alloy, composed of zinc, from 56 to 70 parts; tin, from 18 to 8 parts; copper, 1 part; and antimony 1 part."

35. For an *Improvement in Valve Gear for Steam Engines;* Alfred S. Beebe, Fall River, Massachusetts.

Claim.—"The secondary toe, applied to the main toe, and operating in connexion with a sliding piece, or its equivalent, fitted to the lifter."

36. For an *Improved Yielding Joint for Portable Fences;* Robert J. Brown, Perry, Pennsylvania.

Claim.—"1st, The double dove-tail mortise and tenon joint of vertical posts, whether of square or triangular scantling, and the rails, whether horizontal or inclined at an angle. 2d, Enlarging the circular or square picket holes of rails, on the side facing the picket."

37. For an *Improvement in Floats for Steam Boilers;* William S. Blake, Boston, Massachusetts.

Claim.—"The application of a steam gauge vapor generative float, with a closed steam boiler, and so as to have its contents vaporized by the heat of those in the boiler, in manner and for the purpose of resisting their pressure, exerted internally on the float, the boiler thus serving by the heat of its contents, to produce the agent by which the pressure of the steam on the external surface of the float is neutralized."

38. For an *Improved Machine for Pressing Hollow Brick or Building Blocks;* M. and J. H. Buck, and F. A. Cushman, Lebanon, New Hampshire.

Claim.—"Operating the plunger, by means of the peculiarly constructed cam, in combination with toggle and cross-pin—when the same are constructed and arranged to operate in relation to each other."

39. For an *Improvement in Elliptographs;* James W. Campbell, Brooklyn, N. Y.

Claim.—"Attaching the bar to the two beams of the plates, the pen being secured at the centre of said bar."

40. For an *Improved Gas Burner;* Job Cornell, Brooklyn, and Barnett McDougall, City of New York.

Claim.—"Increasing the width of the slit of the burner towards the centre, and bringing it to a sharp point, or nearly so, at the extremities."

41. For an *Improvement in Machines for Cutting the Stalks of Standing Corn;* Wm. B. Coates, Philadelphia, Pennsylvania.

Claim.—"The oblique knife, in combination with the connecting rod, universal joint, and crank, said rod being made adjustable for the purpose specified."

42. For an *Improved Arrangement of Valves, &c., in Siphon Rams;* Erastus W. Ellsworth, East Windsor Hill, Connecticut.

Claim.—"The combination of either or both the valves of the ram, with a governing key, whereby any or all of the same objects are accomplished, either in a siphon ram, or in a common hydraulic ram."

43. For a *Process for Mashing Grain;* Elie Joseph Hainaut, Kingdom of Belgium.

Claim.—"The process of mashing the grain or grains, either separately or combined, for the triple purpose of obtaining alcohol yeast, designed to be dried and pressed, and a mash sediment suitable for feeding cattle; the principal feature of which process consists in heating the said grain or grains in the macerator, by steam applied externally, instead of injecting the steam directly into the mass, as has been heretofore the practice."

44. For an *Improvement in Pocket Lamps:* Horace L. Hervey, Quincy, Illinois.

Claim.—"The combination of the revolving match holder, with the pawls, and spring catch, and the extinguisher, for the purpose of a portable pocket lamp."

45. For a *Portable Prairie Fence for Stock-pen;* Thomas Hoge, Waynesburgh, Pa.

Claim.—"The fence, or any other which will not collapse in being moved, arranged on a series of wheels, which are capable of being raised and lowered, and when lowered, locked."

46. For an *Improvement in Water Gauges for Steam Boilers;* F. A. Hoyt, Boston, Massachusetts.

Claim.—"The arrangement of the outside vessel, the dry steam chamber, and the float, having a direct communication with the indicating hand."

47. For an *Improvement in Teeth for Reaping Machines;* M. G. Hubbard, Penn Yan, New York.

Claim.—"Forming a tooth, by constructing the core thereof."

48. For an *Improvement in Potato Diggers;* William Mussehl, City of New York.

Claim.—"The revolving separator, in combination with the adjustable inclined shovel and mould boards."

49. For an *Improved Planing Machine;* Hudson Osgood, Waterville, Maine.

Claim.—"My improved arrangement of the endless bed and the belt of planes: that is, so that when a board is being planed by such, it shall be moved transversely under the planes, and the planes be drawn longitudinally over and against its surface."

50. For an *Improvement in Machines for Forging Iron;* Silas S. Putnam, Boston, Massachusetts.

Claim.—"The arrangement of the four hammers operating in pairs, and actuated by a single central cam."

51. For an *Improved Approach-opening Gate;* Wm. G. Phillips, Newport, Del.

Claim.—"Opening and closing a reciprocating gate or gates, by means of a falling weight, through the intervention of the cords, cranks, and rods."

52. For an *Improvement in Nut Machines;* Charles Ratcliff, Cincinnati, Ohio.

Claim.—"The two sets of dies, counter dies, and punches, arranged alternately upon the peripheries of a pair of rolls."

53. For a *Process of Preparing Tannate of Lime;* Obadiah Rich, Cambridge, Mass.; patented in England, Dec. 18, 1854.

Claim.—"The preparation of the tannate of lime, for manufacturing or commercial purposes."

54. For an *Improvement in Washing Machines;* Issac S. Roland, West Earl, Penna.

Claim.—"The arrangement of the article to be washed, around the periphery of a revolving reel, in combination with the application of loose balls or blocks, both inside and outside thereof."

55. For an *Improvement in Corn Shellers;* Hamilton E. Smith, Philadelphia, Pa.

Claim.—"The combination of the cylinder and concave, when made and operated together."

56. For an *Improvement in Lathes for Irregular Forms;* Lemuel Smith, Plymouth, Connecticut.

Claim.—"The two expanding jaws, placed on the carriage, which works on the bed of the turning lathe, in combination with the pattern, the cutter being attached to one of the jaws."

57. For an *Improvement in Churns;* Charles A. Shaw, Biddeford, Maine.

Claim.—"Combining with the pendulous frame, and the mechanism connected therewith, for imparting to the dasher up and down motions, a mechanism, which at the same time will rotate the dasher on its axis, the dasher thus having at one and the same time, a compound movement, consisting of one in line of its axis, and one of rotation on its axis, whereby the operation of churning is greatly improved and facilitated."

58. For an *Improvement in Harvesters;* Wm. Tinker, Kelloggsville, Ohio.

Claim.—"The employment of the freely turning support, in combination with the bent lever, and scolloped wheel, for the purpose of securing said lever from strain, and at the same time of retaining the utmost facility and freedom of motion thereof."

59. For an *Improvement in Implements for Rolling Seeds in the Earth;* Anson Thompson, Glenn's Falls, New York.

Claim.—"The combination with the two series of separately revolving wheels, or narrow rollers, arranged (the several rollers and each series,) relatively to each other, of the frames constructed of slate, in connexion with the wheels."

60. For an *Improvement in Cleaning the Top Flats of Carding Engines;* Wm. H. Walton, City of New York.

Claim.—"Suspending the top flats, or lags. upon pivots in the centre of their ends, by which they can be raised out of the way of the adjoining flats or lags, to be turned by means of a rack, working in pinions upon their pivots, or the equivalent thereof. Also, stripping the flats, or workers, by a rotating brush, so arranged that a card may, in turn, strip the brush and return the strippings to the main cylinder."

61. For an *Improved Method of Cutting Curved Mouldings;* John J. Westerfield, New Brunswick, New Jersey.

Claim.—"The inclined bed either of quadrant, circular, or elliptical form, and the conical head provided with curved cutters."

62. For an *Improvement in Seed Planters;* Henry Wyant, Knox County, Indiana.

Claim.—"The employment of the seed cup. or ring, and spring, attached to and moving with the slide, in combination with the inclined plane of the beam and brush."

63. For an *Improvement in Machines for Sticking Pins;* Charles Atwood, dec'd., late of the City of New York, per his Administrators.

Claim.—"1st, The twisted inclined conductors, as a means of changing the position of the pin. 2d, The falling railway. 3d, The separating, measuring, and spacing bolts, or instruments, terminating in a double inclined plane. 4th, The retarding spring, for holding the pins in check upon the rails, while being acted upon by the dividing instruments. 5th, The chuck for holding, guiding, and moving the paper. 6th, The elevator or plate for raising, holding, and delivering the paper. 7th, The connexion of the guiding grooves with the follower, or driver, in combination with the falling railway, and the retarding spring, and also of the guiding grooves and railway, in combination with the dividing, separating, and spacing instruments used, in combination with the inclined conducting channel."

64. For an *Improvement in Cigars;* Wm. P. Surgey, Hackney, Great Britain, Assignor to Charles H. Stanley, City of New York; patented in England, September 25, 1854.

Claim.—"Cigars, cheroots, and cigarettes, as a new and useful article of manufacture."

65. For an *Improvement in Machines for Husking Corn;* John Taggart and Leonard A. Grover, Roxbury, Assignors to selves and E. W. Banker, Boston, Mass.

Claim.—"The combination of the endless receiving and discharging carrier, the rotary cutter or saw, the inclined grated spout, and the toothed drum."

66. For an *Improvement in the Cylinder and Piston of Hydraulic and Steam Engines;* John Underwood, Lowell, Massachusetts.

Claim.—"The cylinder and piston."

67. For an *Improvement in Churns;* Wm. A. Vetrees, Winchester, Missouri.

Claim.—"The air tube, with its double acting valve."

68. For an *Improvement in Machines for Husking Corn;* Robert Bryson, Schenectady, New York.

Claim.—"The combination of the two endless aprons, corrugated rollers, and guard."

69. For an *Improved Machine for Stamping Leather, combined with a Rolling Machine;* Frederick Berry, Harrisburg, Pennsylvania.

Claim.—"The roller, which brings the stamp lever into action with the studs, when it falls off the leather on to the table, as the leather passes through the rolling machine."

70. For an *Improvement in Feed-water Pumps for Steam Boilers;* Erastus W. Ellsworth, East Windsor Hill, Connecticut.

Claim.—"The method of making a steam pump when applied to maintaining the level of water in steam boilers, or of other liquids in similar vessels, regulate its own speed by causing the liquid, when at or above the proper level, to apply resistance to the motion of the engine of the pump; that resistance being caused by the circulation of said liquid back and forth, through a narrow passage communicating between the above mentioned boiler or vessel, and a variable cavity operated by said engine—said variable cavity being constituted by a piston and plunger working in a cylinder, or in any similar manner, whereby substantially the same result is accomplished."

71. For a *Machine for Paging Books, &c.;* R. L. Hawes, Worcester, Massachusetts.

Claim.—"The general construction and arrangement of the machine, that is to say, pivoting the lever, which carries the numbering wheels to the frame work, and operating the wheels by means of the dog, the arm, and pin. Also, in combination with the method of giving the impression by means of the revolving ribbon, I claim, giving to each type an independent bed or platen, and supporting the platen upon springs."

72. For an *Improved Mode of Incorporating Bituminous Liquids with Wet Earths for Cement;* Willis H. Johnson, Springfield, Illinois.

Claim.—"The combination of bituminous liquid and aqueous cements or mortars."

73. For an *Improvement in Seeding Machines;* James M. Kern, Morgantown, Va.

Claim.—"The combining with a seed box provided with a double set of passages, a hinged centre board, for the purpose of sowing both small or coarse grain, separately, or both at the same time, or grain and fertilizers."

74. For an *Improvement in Churns;* Goodrich Lightfoot, Elgin, Illinois.

Claim.—"The adjustable floats or buckets attached to the annular plate, which is secured to the shaft."

75 For *Candle Dipping Machines;* C. A. McPhetridge, St. Louis, Mo.

Claim.—"Dipping candles on a continuous wick, from spools, by pressing it through heated bees-wax in vat through gauge plate, and then alternatley through heated tallow and cold water, and through steam gauge box, and then separating them by means of the cutters. Also, the steam chambers or floats."

76. For an *Improvement in Seed Planters;* Edwin Moore, Avon, New York.

Claim.—"The hollow arms provided with flaps and beaks, or shares, at their ends—the arms being attached to a hub, provided with passages and cogs, and the perforated disk, and cut-off plate underneath the hopper."

77. For an *Improvement in Connecting Tubes;* Joseph Nason, City of New York.

Claim.—"The mode of joining the straight parallel tubes to the cross tubes, by means of screws and plain cylindrical joints upon the tubes, and screws upon both ends of the tubes—whereby the tubes are made to hold the cross tubes firmly in position, and the cylindrical ends of the tubes are left free to adjust themselves in their openings during the process of entering and screwing up the tubes, and afterwards when expanding unequally."

78. For an *Improvement in Making Cast Steel;* John Neville, City of New York, Assignor (through self and Lemuel Curtis, of New York aforesaid,) to the Damascus Steel Manufacturing Company, Croton, New York.

Claim.—"The process for converting wrought iron into cast steel, consisting essentially in the use of the various compounds of cyanogen and of sal-ammoniac, either separately or in combination with each other, or with other ingredients, when mixed and fused with the wrought iron which is to be thus converted."

79. For an *Improved Mode of Making Gutta Percha Cord;* James Reynolds, City of New York.

Claim.—"The process of finishing gutta percha cord by means of dies and grooved rollers, arranged and operating together, and on the cord—the said dies being of larger diameter than the grooves in the rollers, and serving to close up flaws, draw and compress the cord, and equalize its size, while the smaller grooves in the rollers serve to slightly compress and give a smooth finish to the cord, and establish or sustain the feed of the cord without risk of bruising by attrition, through a windlass action, and by which combined action of the dies and rollers, the cord is stretched to its 'fixed point' between the dies and rollers."

80. For an *Improvement in Prairie Ploughs;* Marshall Turley, Galesburg, Illinois.

Claim.—"The arrangement of the standard mould-board and side cutter, with regard to each other, and to the other parts of the plough, so that they will operate."

81. For an *Improved Trap for Catching Fish, &c.;* Levi Van Hoesen, Westville, Connecticut.

Claim.—"Forming the plates of the jaws and the stem or head piece, with portions of hollow spheres, for the purpose of protecting the bait when the jaws are sprung."

82. For an *Improvement in Ploughs;* George Watt, Richmond, Virginia.

Claim.—"The curved standard, when its front or concave side is rounded off, in combination with the undulating lines, extending from the point of the plough to the tail of the mould board, and when formed by the intersection of the two curvilinear surfaces of the mould board and the standard."

83. For an *Improvement in Seeding Machines;* Moses D. Wells, Morgantown, Va.

Claim.—"The combination of the case with the swinging protruding agitators thereof, and the reciprocating bar contained within the case, and actuating the vibrating agitators."

84. For an *Improved Method of Charging the Receiver of a Locomotive with Compressed Air from Fixed Stations;* Samuel Carson, Assignor to the American Railway Manufacturing Company, City of New York.

Claim.—"The method of charging the receiver of a locomotive with compressed air, or other permanently elastic gas, from fixed stations, whilst the locomotive is in motion, and passing the station by means of the self-adapting apparatus."

85. For an *Improvement in Printing Presses;* Charles G. Sargent, Lowell, and Abram Keach, Boston, Assignors to Abram Keach and Caleb M. Marvel, Lowell, Mass.

Claim.—"1st, The method of operating the bed by means of the pins and the forked lever, when the motion of the latter is controlled by the spring lever. 2d, The wheels, constructed and operating in combination with the toes, whereby the nipper chain is fed simultaneously, and at the required moment receives a slight motion forward, for the purpose of opening one set, and closing another set of the nippers. 3d, The method of hanging and arranging the nipper chain and the platen upon the wheels and ways, whereby the platen may be moved out of the way, when it becomes necessary to change the form."

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86. For an *Improvement in Adjustable Cant Hook for Moving Logs, &c.;* Mark Allcutt, Hancock, New Hampshire.

Claim.—"The arrangement and combination of the lever, with its pawl and slot, and the hook with its ratch notches."

87. For an *Improved Machine for Grinding Saws;* Emanuel Andrews, Elmira, N. Y.

Claim.—"1st, The manner for decreasing the transverse motion of the stone when I wish to grind the most, as at the outer edge of the saw, and increasing the same when I wish to grind less, as at the centre of the saw. 2d, The manner for the adjustment of the stone, for the purpose of using a portion of the grinding surface of the same at pleasure, or all the grinding surface if desired. I also claim, grinding saws to a taper, by means of the adjustable face plates, in combination with the pivot boxes, and sliding and yielding guides."

88. For an *Improved Case for Padlock;* Solomon Andrews, Perth Amboy, N. J.

Claim.—"The making of the body or case of a padlock, of one piece of wrought metal."

89. For an *Improved Method of Planing and Tapering Wooden Hoops;* Clark H. Brown, Forest Port, New York.

Claim.—"The combination of the saw and the adjustable or sliding planer, operated or adjusted by the movement of the carriage, through the medium of the lever, and the pendent, and arm, on the carriage."

90. For an *Improvement in Bake Pans;* Wm. Beach, Philadelphia, Penna.

Claim.—"The construction of metallic bake pans, with rounded corners, formed by notching, cutting, lapping, and riveting."

91. For an *Improvement in Valve Motions for Steam Engines;* John Butler, Dunmore, Pennsylvania.

Claim.—"The arrangement of the two rock shafts, with their rockers operating upon a yoke, or its equivalent, attached to the valve stem, and rock shafts deriving motion from separate eccentrics."

92. For an *Improved Spring Bolt;* Wm. E. Copeland, Fall River, Massachusetts.

Claim.—"My improved arrangement of the stop lever with respect to the bolt, and so as to operate therein, and into and out of the bolt case. Also, combining with the main spiral spring, the secondary and separate spiral spring (or its equivalent), when the bolt is applied to its case, and the springs are arranged within a trapezoidal recess, or chamber of the bolt."

93. For an *Improvement in Pumps;* Jabez Coney, Boston, Massachusetts.

Claim.—"1st, Producing the reciprocating movement of the pump pistons, by the oblique disks, steel balls, and adjustable steel sockets. 2d, Constructing and arranging the duplicate cylinders, with their double acting pistons, in any odd number, five being the best, around the driving shaft, with its oblique disk, so as to be operated thereby from the centre. 3d, Enclosing the working parts in an oil cylinder, to keep them lubricated and free from dirt."

94. For an *Improvement in Railroad Car Coupling;* Charles Flanders, Charlestown, Massachusetts.

Claim.—"Combining and arranging the lifter and the spring, with the pin, the draw bar, and the elevating lever, so as to operate therewith."

95. For an *Improvement in Skate Runners;* John E. Forbes, Hoboken, N. J.

Claim.—"Forming the iron or runner of two parts or plates."

96. For an *Improved Filtering Faucet;* George H. Fox, Boston, and Henry J. Siller, East Cambridge, Massachusetts.

Claim.—"Causing a portion of the water, which has passed through the filter, to return in the opposite direction whenever the cock is closed, after using it for the purpose of cleansing the filter."

97. For an *Improvement in Lifting Jack;* Harvey Gray, Bristol, Connecticut.

Claim.—"The employment of the screw, yoke, roller, pawls, ratchets, in combination."

98. For an *Improvement in Sewing Machines;* James E. A. Gibbs, Mill Point, Va.

Claim.—"1st, Feeding up the thread to the needle by connecting the needle thread with the cloth feed motion, or by giving the needle thread an independent feed motion, so that there shall be sufficient thread, and no more, at each stitch fed in to the needle, to form the stitch—thereby causing the needle to draw the shuttle thread into the cloth, and never above it, for the purpose of ensuring the meeting of the loops or locks, within the body of the cloth. 2d, Fastening the cloth upon a slotted table moving with a rectilinear motion by means of a slotted curved spring—the slots in both spring and table corresponding with each other, and holding the cloth on both sides of the seam."

99. For an *Improved Portable Water Mill;* John Heller, East Lampeter, Penna.

Claim.—"The portable quadruple water power."

100. For an *Improved Portable Field Fence;* James G. Hunt, Reading, Ohio.

Claim.—"The compound triangular brace, in combination with the projection of one or more rails in whole part of one section or panel, beyond the slats or battens, and between the slats or battens of the adjoining panel."

101. For an *Improvement in Sewing Machines;* Lewis Jennings, City of N. York.

Claim.—"1st, The formation of the seam from a single thread, by passing each loop after it has passed through the cloth or material to be sewed, through its immediate successor, and round the second one which succeeds it, by means of a needle and a thumb, and a 'thumb and finger.' 2d, The combination of the arm, to which the thumb and finger are attached, the pivot, the slotted arm, the fixed pin, and the lever."

102. For an *Improvement in Ships' Windlass;* Peter H. Jackson, City of N. York.

Claim.—"The double-acting pawl, crank arm, and counter weight, applied to the heaver or heavers of the windlass."

103. For an *Improvement in Machinery for Grinding Paper Pulp;* Joseph Kingsland, Jr., Franklin, New Jersey.

Claim.—"The combination of the revolving grinding disk, having play in the direction of its axis, with the fixed grinding disks on either side of it, whereby the revolving disk is free to adjust itself, at such varying relative distances from the fixed disks as may be required to prevent the grinder from clogging, and to adapt it to working properly upon different qualities of fibre, and under different rates of feeding. Also, the arrangement of the feeding and discharging orifices of the grinder and its grinding surfaces, so that the motion of the revolving disk will facilitate the entrance of the fibre into the grinder, tend to retard its discharge therefrom until properly reduced, and to keep it, while in at those places, where the grinding action is most energetic."

104. For an *Improvement in Machines for Paring Apples;* Horatio Keyes, Leominster, Massachusetts.

Claim.—" Giving the knife a circular movement entirely around the fork and apple thereon, by means of the wheel, with the arm and knife head attached, and the cam."

105. For an *Improved Boring Machine;* Samuel Klahr, Reamstown, Penna.

Claim.—" The arrangement and combination of the shaft, endless screw, pinion, and pulleys, as co-operating on an endless chain and railway carriage, for the purpose of boring pump stocks. Also, the shape and construction of the pinion and pulleys, with pins solid on one shaft. Also, the combination and arrangement of the drum, with the devices for operating both of the carriages for boring posts and pump stocks."

106. For an *Improvement in Photographic Baths;* William and William H. Lewis, City of New York.

Claim.—" Retaining the nitrate of silver bath in the desired inclined position, by the combined operation of the leg and button. Also, the solid glass pot, when formed with the curved sides and bottom, for the purpose of protecting the plate from injury, by contact with the bath or any sediment."

107. For an *Improvement in Railroad Gate for Cattle Guard;* Joseph T. McIntyre, Middletown, Delaware.

Claim.—" The arrangement of the tilting platforms, and the tilting cattle guards, with each other, and in connexion with the rails of railroads at the crossings of common roads, in such a manner, that the attempt to pass to the right or to the left from said crossings, on to the track or space between the enclosing fences, will, by the weight of the animals making the attempt, instantly raise a barrier before them, across the entire width of said railway space."

108. For an *Improvement in Harvesting Machines;* Robert J. Morrison, Richmond, Virginia.

Claim.—" Hinging the guard or shield by one of its ends to the frame, and supporting the other end thereof on the tongue, so that it may run or move on said tongue when the machine rises or falls, to accommodate itself to the inequalities of the ground, or for passing over water courses."

109. For an *Improved Press for Printing Hat Linings;* William Moultrie, City of New York.

Claim.—" The application and employment of the printing cylinder, or its equivalent, in combination with the feed and impression rollers, the fountain, the endless tapes, the drying vessel, and the revolving brush."

110. For *Improved Chimney Cowls;* Patrick Mihan, Boston, Mass.

Claim.—" My arrangement of hollow frustra with respect to each other, a smoke flue, and an inverted cone deflector, placed at and in the upper end of said smoke flue. Also, arranging on the flat top surface of the deflector, an enclosing deflecting guard, and a discharge spout, the same being disposed so as not only to gather the water which may fall on the top of the cone, and discharge it in one stream upon the inner surface of the upper external frustum, but so that the guard may serve to deflect a current of air which may strike on the top of the cone. Also, providing the cap plate, when it is directly over the conical deflector, with an opening, while the remainder of the cap plate may extend over the opening, between the cone and the outer cone—the same being to allow air to pass through the cap plate, and impinge on the top surface of the cone."

111. For an *Improved Mowing and Reaping Machine;* Jeremiah W. Mulley, Amsterdam, New York.

Claim.—" Connecting the frame of the platform with the frame carrying the driver's and raker's seat, in the manner, namely :—securing the relative position of the two frames, by means of the brace in the rear, and the laterally inclined draw-shoe in front.

Also, the rod and the rails connected, in combination with the pole, the rocking shaft, and the lever."

112. For an *Improvement in Machinery for Weaving Shade Cord;* Thomas Nelson, Troy, New York.

Claim.—"The arrangement of the inclined planes around a circle, and divided from each other by the chasm or pathway—the same being intended as the course or track of the spool cars. Also, the arrangement of the spool cars, in combination with the eccentrics which operate the cars in the rear of the inclined planes by means of pins, or equivalent apparatus, passing from the cars through slots in the planes. Also, the arrangement of carriers or shuttles, attached to the eccentrics, passing through the chasm between the upper and lower planes, and traversing circularly, and delivering the woof or filling between the threads of the warp, as they change their relative positions by the alternate elevations and depressions of the spool cars."

113. For an *Improvement in Grinding Mill;* Thomas B. Stout, Keyport, N. J.

Claim.—"The arrangement and combination of the feeding cavities, feeding apertures, and the form of dress given to the grinding surfaces."

114. For an *Improved Machine for Making Metallic Slats for Blinds;* John S. Samson and Wm. P. Farrand, Philadelphia, Pennsylvania.

Claim.—"The combination of bed, beam, and shear, with the spring stop."

115. For an *Improvement in Reaping and Mowing Machines;* Daniel C. Smith, Tecumseh, Michigan.

Claim.—"The combination of rock shaft, with hollow rock shaft, when the same are connected for joint operation in moving two sickles at once, by means of mechanism, arranged and operated in relation to each other from the main wheel."

116. For an *Improved Machine for Wiring Blind Rods;* Thaddeus F. St. John, Le Roy, New York.

Claim.—"1st, The device formed of the reciprocating bars, provided with the lever, having a hook at its lower end, the bars attached to the uprights—the lever being operated—by which device the staples are properly formed, and when formed, driven or forced into the rods or slots. 2d, The combination of the reciprocating bars and lever, arm, or lever, with the cutter attached, and the cam—the whole being arranged and operating conjointly."

117. For an *Improved Finger Bar for Harvesting Machines;* William H. Seymour, Brockport, New York.

Claim.—"1st, Casting the finger bar, composed of an upper and an under plate, united by the guard fingers, all in one piece. 2d, The openings in the back of the hollow finger bar, in combination with the inclined ribs. 3d, Ribs or partitions."

118. For an *Improved Mode of Securing Springs in Upholstery;* Wendell Wright, City of New York.

Claim.—"Securing the spring to its seats by having annular grooves made in the seats, one in each, and having the greater portion of the coils at the ends of the springs made or bent in horizontal form, and somewhat larger in diameter than the grooves, so that they will have a requisite bearing on the seats, and be retained by their elasticity within the grooves."

119. For an *Improvement in Apparatus for Coal Oil;* Richard Shroder, Darlington, Assignor to John S. Russell, Pittsburgh, and Richard Shroder and Alexander Anderson, Beaver County, Pennsylvania.

Claim.—"Constructing the retort or generator, with openings at different heights, for the purpose of obtaining oil of different qualities."

120. For an *Improved Machine for Cutting and Folding Paper;* Charles Moore, Hartford, Conn., Assignor to Wm. G. Sheldon, City of N. Y., and Lorenzo B. Chandler and Charles Moore, Hartford, Connecticut.

Claim.—"1st, The use of a frisket, with a blade or cutter attached thereto, in combination with a stationary cutter or blade, for the purpose of cutting a sheet of paper in two parts, by one and the same operation. 2d, The crimping blades. 3d, In combination with the crimping blades, the use of folders either with or without the auxiliary frisket. 4th, The use of auxiliary friskets, when operated by projecting pins, or by any other competent mechanism, in conjunction with the folder, to carry over such parts of the sheet to be folded as will not, when operated upon by the folding blade, sustain and carry over their own weight. 5th, The combined contrivance of the take-off, and the crimping blade of the last fold, or the combination of the take-off with any other blade designed to co-operate therewith, for the purpose of clasping the folded sheet, or sheets, and of carrying them off, and of discharging them from the machine. 6th, The arrangement of the spring and pawl, or their equivalents, operating the take-off. 7th, The use of sliding or movable beds, with hanging sides, as a means of arranging the cutting, crimping, and folding mechanism, and all the cams, levers, springs, racks, &c., which operate the same, so that the machine may be expanded or contracted without disarranging the parts on which the proper motions depend. 8th, The punching points or pins, in connexion with the corresponding holes of the crimping blade."

121. For an *Improvement in Wind Mills;* Solomon W. Ruggles, Assignor to Silas Ruggles, Fitchburg, Massachusetts.

Claim.—"The disk and buckets, in combination with the wire or rod connected with the vane."

122. For an *Improvement in Reaping and Mowing Machines;* Thomas D. Burrall, Geneva, New York.

Claim.—"Placing the front edge of the cutter bar on the line, or nearly so, of the front edge of the finger board, when said finger board is formed with the raised front edge or lip, leaving free space below and behind the cutter bar, for any extraneous substances to escape from beneath said cutter bar, and pass freely away to the rear, with the grass or grain."

123. For an *Improved Apparatus for Drying Grain in the Mass;* John C. Pedrick, Washington, D. C.

Claim.—"The double convex lenticular vessel or perforated exhaust chamber, or its equivalent, for drying grain in bulk, in granaries or in vessels."

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124. For an *Improvement in Ploughs;* Jonathan Adams, Eatonton, Georgia.

Claim.—"The peculiar manner of holding the slotted mould-board, share, or hoe, to the stock, viz: by means of the curved brace, with its shank and shoulders extending from the beam, and against and through the hoe and stock."

125. For an *Improvement in Cider Mills;* Harry Abbott, Huron, New York.

Claim.—"The arrangement of the small pressing rollers in the arc of a circle, upon vibratory arms, to which the pressing power is applied."

126. For an *Improvement in Steam Boilers;* John Armstrong, New Orleans, La.

Claim.—"The series of cylinders placed vertically in rows, with a series of horizontal flues passing through each row, and lying in the vertical plane, cutting the centre of each cylinder—the space between each row of vertical cylinders being closed at the top by a horizontal flue boiler, all the vertical cylinders being connected together at the top and the bottom, and the furnace being located in one end of the space between the rows of vertical cylinders."

127. For an *Improvement in Printing Presses;* G. H. Babcock, Westerly, R. I.

Claim.—"1st, Attaching the bed and the platen together by means of the joint, when each is made to oscillate from a fixed centre. 2d, Giving an impression by means of the joint oscillation of the bed and platen. 3d, Operating the frisket by means of the weight, in combination with the motion of the platen."

128. For an *Improved Mode of Securing Braces in the Snath of a Grain Cradle;* Wm. W. Ryan, Schaghticoke, New York.

Claim.—"The application of a wedge-formed bolt or pin."

129. For an *Improved Portable Field Fence;* Wm. B. Burnett, Lyons, New York.

Claim.—"Constructing the panels of a portable fence with alternately abutting rails, in combination with the binding clamp."

130. For an *Improvement in Machinery for Folding Paper;* Chauncey O. Crosby, New Haven, Connecticut.

Claim.—" 1st, The combination of the blades with the griping bars. 2d, The blades, in combination with the fingers. 3d, The cutting away a portion of the face of one of each pair of griping bars, and also of the edge of each of the blades, so that I may gripe the paper without binding the blades."

131. For an *Improvement in Rotary Egg Beaters;* Ralph Collier, Assignor to Alfred H. Reip and Ralph Collier, Baltimore, Maryland.

Claim.—" Vertically revolving stirring blades, made of metallic wire."

132. For an *Improvement in Stoves and Furnaces;* Theodore Cook, Springfield, Mass.

Claim.—" The fire chamber or pot, chamber, and cases, provided with the necessary pipes."

133. For an *Improvement in Machines for Cutting India Rubber Thread;* Henry Davenport, City of New York.

Claim.—" The combination of the cylinders or drums, over which the endless belt of india rubber from which the thread is to be cut is stretched, with the revolving circular cutters attached to the table."

134. For an *Improved Hand Printing Press;* Platt Evans, Jr., Cincinnati, Ohio.

Claim.—" So connecting the platen with the follower, that the upward motions of the follower shall remove the platen from the ink pad, and bring it back again, and during every alternate downward motion of the follower, the platen shall remain over the ink pad, and under the type follower. Also, the mode of communicating the motions of the follower to the platen—the same consisting of the double inclined guide, with its stops or checks, and the forked toggle, operated by a spring, and having bearings in the short arm of the lever."

135. For an *Improvement in Looms;* Andrew L. Fuller, Clinton, Massachusetts.

Claim.—" Regulating or changing the feed by governing the action of the lever, by means of the graduated stop, or its equivalent, in connexion with the change of a slide and pattern. 2d, The guard, for lifting the fingers. 3d, The flexible connexion between the stop and the rod, or slide, to allow motion to the stop, without moving the slide."

136. For an *Improved Spring Hinge;* John T. Garlick, City of New York.

Claim.—" A hinge, or series of hinges, attached to a double leafed spring."

137. For an *Improved Hoof Expander;* C. B. and S. Galentine and A. J. Russell, Nunda, New York.

Claim.—" The application of any instrument worked by a thumb screw, or other form of lever, so small as not to interfere with the operation of nailing the shoe to the hoof of the animal."

138. For an *Improvement in Mowing Machines;* Andrew M. Hall, West Falmouth, Maine.

Claim.—" Operating the pitman."

139. For an *Improvement in Trimming Card Clothing;* Edward B. Howe, Lowell, Massachusetts.

Claim.—" The arrangement of the adjustable guide and clamp, with its adjustable tool holder operated thereon, and the guide bar for guiding the card clothing by the card teeth set therein, and the points in this bar to hold the card clothing while it is being trimmed, on both edges at the same time, and parallel with the card teeth therein."

140. For an *Improvement in Bedstead Fastenings;* Sandy Harris, Philadelphia, Pa.

Claim.—" The combination of the dove-tail with the staple, or mortised projection, termed the wedge box, and its key, acting upon an inclined face."

141. For an *Improvement in Ploughs;* Jacob Heckendorn, Elkton, Maryland.

Claim.—" The twisted, four coultered, double-ended, and reversible, self-sharpening point, formed of one piece or casting, and operating as point and coulter."

142. For an *Improvement in Paper Pulp Engine;* Joseph Kingsland, Jr., Franklin, New Jersey.

Claim.—"The method of regulating the feeding of the fibre to the grinder, by varying the hydraulic pressure by means of an adjustable discharging nozzle."

143. For an *Improvement in Hemp Brakes;* Edward W. Lacy, Oak Park, Va.

Claim—"The adjustable weight to be used with, or governed by a treadle roller, to regulate at pleasure the momentum of the blow upon the stalks."

144. For an *Improved Machine for Pointing Shoe Pegs;* Jesse Ladd, Holderness, New Hampshire.

Claim.—"The employment of the fluted or toothed feed roller, in combination with the vibrating bed, composed of the fingers, &c."

145. For an *Improvement in Sewing Machines;* Wm. R. Landfear, Manchester, Conn.

Claim.—"1st, The manner of regulating the length of stitch, by raising and lowering the fulcrum—thereby changing the relative lengths of the two arms of the lever. 2d, The manner of combining the shuttle guide with the crank and fulcrum, for the purpose of giving the shuttle a downward motion when the stitch is tightened."

146. For an *Improved Door Fastener;* James Letort, Wytheville, Virginia.

Claim.—"The employment of the bent lever bolt, when in combination with the blade, or other additional blades."

147. For an *Improvement in Blacksmith's Crane;* Wm. Maher, Slack, Kentucky.

Claim.—"The horizontal bar hung upon the screw, and used in connexion with the windlass."

148. For an *Improved Device for Operating Fluid Metres by Hand;* Wm. Mason, Warren, Massachusetts.

Claim.—"The two concave flanched disks, and the flexible diaphragm, and provided with any suitable arrangement of passages, and with a faucet, or its equivalent, to change the passages to admit water to each side of the flexible diaphragm alternately."

149. For an *Improvement in the Manufacture of Hosiery;* William H. McNary, Brooklyn, New York.

Claim.—"The production of the heels and toes of hosiery, by knitting a spherical piece on the cylindrical or straight portions of the leg or foot, by the mode of operation whereby the same number of stitches is always left remaining on the needles, and the cylindrical or straight portion is enabled to be proceeded with again, when desired—thus enabling the whole leg and foot to be produced by a continuous operation of the devices or machinery employed."

150. For an *Improved Arrangement of Railroad Platform Scales;* Lea Pusey, Downingtown, Pennsylvania.

Claim.—"The arrangement of the platform of a railroad scale, either in the main or subsidiary track of a railroad, so that when the said platform is not in use for weighing as a railroad scale, the locomotive and train may pass directly over the same without bearing upon the said platform or scale; and also, so that the cars may be passed on and off the said scale in the course of weighing without crossing the track, and, therefore, without using a 'frog,' or its substitute—whereby all the advantages, heretofore derived from a 'siding' constructed for preserving the scale from the injurious effects of the locomotives and trains passing rapidly over it, are equally attained, and the room and expense required for the construction and use of the said 'siding' entirely avoided."

151. For an *Improvement in Hot Air Furnaces;* John H. H. Perkins, Utica, N. Y.

Claim.—"The mode of heating air for warming purposes, by passing it through the hot air chamber, in close sub-chambers and pipes; the main chamber being filled with air and steam commingled, and heated by the furnace or stove."

152. For an *Improvement in Breech Loading Fire Arms;* Hermann Schroeder, Louis Salewski and William Schmidt, Bloomington, Illinois.

Claim.—"The cocking of the hammer, in the act of moving the barrel forward to charge it, by a combination of mechanical parts."

153. For an *Improvement in Shirts;* Seligman H. and Joseph Strouse, City of N. Y.

Claim.—"The yoke constructed with curved springs, in combination with the manner of attaching the same to the back of the shirt, with the gathers in the centre."

154. For an *Improvement in Tinner's Shears;* Levi Skeels, Ostrander, Ohio.

Claim.—"1st. The rotary and sliding clamp, in combination with the straight shears, for the cutting of circular forms. 2d, The arrangement and combination of the hinged bench with the fixed bench or frame, and with the shears."

155. For an *Improvement in Corn Shellers;* Edgar M. Stevens, Boston, Mass.

Claim.—"The self-acting cylinder, in combination with the presser bar and bed."

156. For an *Improvement in Trusspads;* Sylvester I. Sherman, City of New York.

Claim.—"Rendering the joint of truss-pads, rigid in any desired position, by compressing the ball between two plates."

157. For an *Improvement in Preparing Vegetable Fibres for Stuffing Mattresses and Cushions;* Werner Staufen, Prussia; patented in England, Nov. 12, 1855.

Claim.—"A new manufacture as an article for stuffing mattresses, cushions, &c., produced by permanently curling any suitable vegetable fibrous substance by this method."

158. For an *Improved Mode of Connecting Shafts with the Axle-Trees;* Alfred E. Smith, Bronxville, New York.

Claim.—"The manner of connecting the thills or shafts of a carriage with the axle-tree, by means of journals on the plate attached to each of the thills—one of the said journals being of greater diameter than the thickness of the plate from which it projects, and the said journals being fitted to holes in the ears, one of which ears is provided with a slot of less width than the diameter of the journal fitted to its hole, and large enough to allow the plate to slide in it freely."

159. For an *Improved Method of Hanging Reciprocating Gig Saws;* John Stowell, Charlestown, Massachusetts.

Claim.—"Attaching the saw to the two levers, when the axes of said levers are fitted in an oscillating frame, the journals of which are fitted in slots or grooves, or in a swinging frame, to allow a forward and backward movement of the frame."

160. For an *Improvement in Melodeons;* Gideon O. Spence, Elmira, New York.

Claim.—"The application of the third pedal to the receiver of melodeons, for facilitating the production of the crescendo and diminuendo."

161. For an *Improvement in Knitting Machines;* Clark Tompkins, Troy, N. Y.

Claim.—"The improvement of driving the rough roller of the take-up mechanism of a rotary knitting machine, by means of rotary friction plates, or their equivalents, instead of giving a positive rotary motion to this roller, as heretofore; so that this draft roller, with its incumbent take-up roller, without any additional mechanism, or any readjustment, continually gives the same tension to the web in knitting, however much the yarn varies in size, or whether much or little yarn is fed to the needles, or whatever quantity of web is on the take-up roller."

162. For an *Improvement in Lubricating Spindle Steps;* John Welsh, Philadelphia, Pennsylvania.

Claim.—"Making the groove or grooves, or their equivalents, at the lower end of the tube, so as to conduct thereby during the rotary motion of the said tube, the surplus oil from the spindle to the horizontal face of the step."

163. For an *Improved Fountain Pen;* A. F. Warren, Brooklyn, New York.

Claim.—"Attaching the pen holder to the sliding tube, by means of the rod, so that the pen may be drawn within and shoved out from the cylinder or ink reservoir. Also, constructing the pen holder of the two plates and plug."

164. For an *Improvement in Portable Head Rests;* Allen B. Wilson, Waterbury, Conn.

Claim.—"A head rest, composed of a pad, or other piece, to rest upon the back and shoulders, or either, supporting a pad of proper form, to receive the back of the head, or otherwise constructed, support the head without any attachment to the seat, or to any fixed object. Also, making the said head rest with its pads flexible, and its supports consisting of a number of independent or unconnected ribs, so as to give the greatest ease to the wearer, and enable it to be rolled or folded up when not in use. Also, the sling combined with the head rest to receive the arm, for the two purposes of keeping the rest in place, and protecting the pockets."

165. For an *Improved Machine for Trimming Bolts;* Wm. Hannah, Assignor to L. H. Bowen and Wm. Hannah, Middlefield, New York.

Claim.—"The arrangement of the sliding and stationary dies, and operating with the sliding face plate, in connexion with the horizontal lever and eccentric."

166. For an *Improvement in Weighing Scales;* Elnathan Sampson, Assignor to the Vergennes Scale Manufacturing Co., Vergennes, Vermont.

Claim.—"The peculiar arrangement and operation of the respective parts of my improved compound weighing poise, viz: combining the outer portion of said poise with the main portion thereof, in such a manner that the act of rotating the outer portion of the poise, will move it longitudinally upon the main portion thereof, by a graduated movement, and at the same time indicate the different leverage action thereby produced upon the scale beam, by means of a toothed horizontal index on the main portion of the poise, and a spiral groove, and a numbered spiral scale on the periphery of the outer portion of the poise, whilst the entire poise can be moved longitudinally upon a rod situated immediately above the scale beam, and the leverage exerted by said poise, when its respective parts are compactly united, be indicated by a vertical index descending from the main portion of said poise, immediately in front of the numbered scale of the scale beam."

167. For an *Improvement in Converting Reciprocating into Rotary Motion;* Samuel Gissinger and John W. Kellberg, Allegheny City, Assignors to D. A. Morris, Pittsburgh, Pennsylvania.

Claim.—"The combination of the disk, having an externally notched rim, and being attached to the shaft to be rotated—the standard, or its equivalent, containing a double arc-formed slot—the bar that is connected by a vibrating rod with the piston rod, or other reciprocating object, the pin, the levers, and springs."

168. For an *Improvement in Burning Charcoal;* Andrew Grimes, Assignor to Charles Day, Lancaster, New York.

Claim.—"Burning wood in the open air, without any covering of earth, or any substitute therefor, in such a manner as to reduce any given amount of wood to a mass of red hot coals—preventing the pile from burning to ashes until the result is accomplished."

169. For an *Improvement in Machinery for Sizing Hat Bodies;* Sylvester H. Gray, Assignor to self and Francis Ives, Bridgeport, Connecticut.

Claim.—"Attaching the guide to the rear end of the vibrating carriage. Also, the use of the adjustable steam chest, in combination with the vibrating carriage, and the revolving endless bed or carriage."

170. For an *Improvement in Looms;* Benjamin G. Dawley, Assignor to Z. Allen, North Providence, Rhode Island.

Claim.—"The use of an intermediate wheel or wheels, to balance and regulate the tension in the delivery of the warp from two or more yarn beams combined together, to form one web of wide cloth."

171. For an *Improvement in Automatic Rakes for Harvesters;* Samuel Comfort, Morrisville, Penna., Assignor to Edward S. Renwick, City of New York.

Claim.—"1st, The combination of the rake handle, the guide, which its upper end traverses, and the lever to vibrate the rake in and out. 2d, The counter loading of the rake, for the purpose of rendering the draft of the machine more equable. 3d, The combination of the rake with the mechanism for moving the same to and fro over the platform, with a traversing carriage. 4th, The method of discharging the gavel before being bound, by dropping it from between the rake teeth and the plate, while the machine is in motion, as if it were standing still, by neutralizing the forward motion derived by the gavel from the machine by its backward motion derived from the rake. 5th, The combination of the rack and pinion, or the equivalent thereof, with the rake, whereby the motions are generated for traversing the rake—first along the platform to gather the grain into a gavel, and then across the platform to discharge the gavel."

172. For an *Improved Machine for Cutting Veneers from the Log;* Joseph H. Goodell, Bridgeport, Connecticut.

Claim.—"The combination and arrangement of the reciprocating log-carrying slide, unsupported by trunnions or axles for its curvilinear play, with the fixed guiding strips, and stationary knife, when said guiding strips serve as the sole guide to give to the log carrier its curvilinear movement and simultaneous side action; whereby a steadier and more reliable united double bearing is given to the log in its movements, the log may be secured with facility to the carrier, and the driving power is communicated to the log in a more positive and direct manner, for cutting with increased ease and precision thin veneers. Also, hinging the knife holding frame to the main knife feeding slide or frame, for the easy and double adjustability of the knife."

173. For an *Improved Method of Adjusting the Bits of Carpenter's Planes;* Thomas D. Worrall, Lowell, Massachusetts.

Claim.—"The arrangement of the rack and pinion, and the clamp, so that while the pinion is placed within the clamp, the rear or dove-tailed sides of the rack bar shall serve as bearings for the clamp to work against."

174. For an *Improvement in Spring Bed Bottoms;* Elkan Adler, City of N. York.

Claim.—"The combination of the metal caps, connecting links, or straps, and springs."

175 For an *Improved Machine for Feeding Paper to Printing Presses;* Moses S. Beach, Brooklyn, New York.

Claim—"Turning the sheet and delivering it to the impression cylinder for a second impression, by means of an extra or second cylinder, or its equivalent. Also, the arrangement and construction of the twin-fingers."

176. For an *Improvement in Horse Fastenings;* James Bolton, Richmond, Va.

Claim.—"The combination of a ratchet wheel with the hub of a wheel of a vehicle, and with a tie rein capable of adjustment, so as to bear equally on both sides of the bit of a horse, or other animal used for draft, whereby the rein is drawn, and the animal is checked if he move forward, and the rein is loosed if he move backward."

177. For an *Improvement in Harvesting Machines;* Joseph Carpenter, Yorktown, New York.

Claim.—"The employment or use of the two levers connected by the strap, and attached to the frame and bars, to which the wheels are attached."

178. For an *Improvement in Seed Planters;* N. C. Sherman and J. Mason, Hazle Green, Wisconsin.

Claim.—"The double plunger, having bars operating and combined with the seed box."

179. For an *Improvement in Sewing Machines;* A. F. Johnson and F. A. Houghton, Boston, Massachusetts.

Claim.—"The arrangement of parts of a spring power mechanism, when combined with a sewing machine, and located in a box, forming the pedestal of said machine. Also, the device by which the machine is made self-regulating, as to speed—consisting of the lever, brake, in combination with the fan-wheel attached to the loose collar."

180. For an *Improvement in Process of Grinding Paper Pulp;* Joseph Kingsland, Jr., Franklin, New Jersey.

Claim.—"The process of reducing fibrous matter in water, to pulp, by grinding it under hydraulic pressure, which creates a current that feeds the fibre into the grinder, and removes it therefrom as fast as it is sufficiently reduced, and renders the feeding independent of the grinding."

181. For an *Improvement in Smoke-Consuming Furnaces;* John Case and Isaac Soules, Amsterdam, New York.

Claim.—"1st, The arrangement of the fire and the smoke chambers, the direct and the return flues, the gas and the air pumps, the pipes to supply air above and below the grate, and the waste pipes for the spent gases. 2d, The combination with the smoke chamber and direct and return flues of the diaphragms, to direct the gases downward and backward as they enter the smoke chamber to facilitate the precipitation of the sparks and thoroughly oxydated gases, from those gases which are but partially burnt, and require for the completion of their combustion to be returned to the fire chamber. 3d, The arrangement at or near the bottom of the smoke chamber of an open orifice, for the free and constant escape of the waste gases, in combination with the smoke chamber, and direct and return flues. 4th, In combination with the smoke chamber, arranging the hot gas and cold air pumps."

182. For an *Improvement in Hay Rakes;* John J. Squire, St. Louis, Missouri.

Claim.—"The clutch and levers operating the same, in combination with the arm of the rake shaft, and the connexion between said arm and lever, whereby the rake is lifted by the moving power, and automatically released."

183. For an *Improvement in Manufacturing Callender Rolls;* John Worsley, Providence, Rhode Island.

Claim.—"The use and employment of husks of maize (indian corn), for making rolls instead of cotton, wood, paper, or any other substance now in use."

184. For an *Improvement in Refrigerators;* Charles Winship, New Haven, Conn.

Claim.—"The method of causing the fresh, cold, moist air, to perform the combined double functions, first, of ventilating and refrigerating the interior of the provision chamber, and then of protecting the exterior of said chamber."

185. For an *Improvement in Sewing Machines;* Jerome B. Woodruff, Washington, District of Columbia.

Claim.—"1st, The construction of a feed bar, sliding in a dove-tail or slotted guide, and moved by a lever connected with the feed bar by a swivel joint, or its equivalent, so as always to move the feed bar in a plane with the material being sewed—the feed bar being moved back the distance required for the length of the stitch, while the needle is in the material, and when the needle is withdrawn, is moved forward, carrying the material therewith. 2d, The arrangement of a series of pins, through which the needle thread is laced, for the purpose of giving a uniformity of tension affecting its twist. 3d, A balanced needle bar for sewing machines, when constructed in the form of a segment of a circle, operating the shuttle driver by one end direct, and carrying the needle by the other end, when the whole of said bar forms the arc of a circle, of which the point of suspension is the centre. 4th, A slotted shuttle driver, the same being operated direct from the needle bar, and so arranged that the shuttle may pass through the loop of the needle thread in its proper time, gradually decreasing its speed, and stopping at or about the same time with the needle. 5th, Carrying the shuttle back and forth by a single pin."

186. For an *Improvement in Machines for Sowing Seed Broadcast;* E. K. Haynes, Hanover, Assignor to self and A. M. Mowe, Lebanon, New Hampshire.

Claim.—"The scattering wheel, armed with air-agitating wings, when located between obliquely arranged parallel directing boards."

187. For an *Improvement in Counting Machines;* James A. Bazin, Canton, Mass.

Claim.—"The arrangement of the numbering wheels, and the parts immediately connected therewith; that is to say, hanging the pawls to the central drum within the rings."

ADDITIONAL IMPROVEMENTS.

1. For an *Improvement in Hubs for Carriages;* Joseph Smith, Delaware, Ohio; patented February 19, 1856; additional dated December 16, 1856.

Claim.—"The combination of the boxes, cylinders, band, with the rollers."

2. For an *Improvement in Breech Loading Fire Arms;* Abner N. Newton, Richmond, Indiana; patented June 27, 1854; additional dated June 17, 1854; 2d additional dated December 23, 1856.

Claim.—"1st, The combination of lever with the breech pin. 2d, One or more lips, in combination with the breech pin. 3d, Cocking the gun by the backward movement of the breech pin. 4th, Cocking the gun by the tension lever. 5th, Forcing the part, or its equivalent, between the main spring and barrel, for the purpose of imparting tension to the spring. 6th, Relaxing the main spring, by removing the part. 7th, Attaching the main spring to the barrel. 8th, The combination of the hammer with the barrel, by means of supports. 9th, Sliding the breech pin wholly within the barrel."

RE-ISSUES FOR DECEMBER, 1856.

1. For an *Improvement in Curry Combs;* Wm. Beach, Philadelphia, Penna.; patented March 13, 1849; re-issued Feb. 12, 1850; re-re-issued Dec. 9, 1856.

Claim.—"The combing the trough shaped bars, which have the comb teeth on their edges, with the folded strips of metal which form the transverse bars, and receive the wire through them, forming a square, open, or hollow back comb. Also, the shank constructed with the fastening hole, made by bending the wire which saves the welding or drilling, and combined with the comb, so as to act with transverse bars and guards to the ends of the combs."

2. For an *Improvement in Marble Sawing Machines;* Jose Toll, Locust Grove, Ohio; patented Sept. 9, 1856; re-issued Dec. 9, 1856.

Claim.—"The particular combination and arrangement of the fender bars, with the adjustable guide pieces."

3. For an *Improvement in Sewing Machines;* Allen B. Wilson, Waterbury, Conn.; patented November 12, 1850; re-issued January 22, 1856; re-re-issued December 9, 1856.

Claim.—"1st, The combination in a single machine of these three following elements, namely: a table or platform to support the material to be sewed, holding it for the action of the needle, and presenting it properly to the grasp of the feeding apparatus; a sewing mechanism proper, consisting of a needle and shuttle, or their equivalent, and a mechanical feed automatic, and causing the cloth to progress regularly, to which the cloth is not attached, and so grasping the cloth that it may be turned and twisted by the hand of an operator, such twisting not interfering with the regular progression of the cloth, and the whole being constructed and acting together and in combination with each other. 2d, Moving a shuttle so shaped and held by its race that jaws may embrace it, by means of two jaws, which are alternately in contact with the shuttle, making and breaking their contact without any aid from cams or springs, or the equivalent of such device. 3d, A double pointed shuttle, in combination with jaws for driving it, whereby the shuttle may be thrown alternately from opposite directions through loops, without practically disturbing the loop thread."

4. For an *Improved Magazine Repeating and Needle Gun;* Edward Lindner, City of New York; patented June 27, 1854; re-issued December 23, 1856.

Claim.—"1st, The application of the rack, situated between the gun barrel and the cartridge barrel. and the construction of the piston, in connexion with the said rack, for the purpose of passing the cartridge into the revolving breech piece. 2d, The spiral spring round the needle, together with the jointed arm at the upper end of the hammer, acting upon the needle in such a manner that after said jointed arm has pressed the needle sufficiently far into the cartridge to ignite the priming, said arm is forced upwards, allowing thereby the needle to spring suddenly back, and pass under the arm by the action of the spring, by which any heating of the needle is prevented. 3d, Revolving the breech by the pin, when the said pin is so constructed and arranged that it will rotate after the revolution of the breech piece, and turn over at the moment it shall have passed the spiral groove, and return to its former position inclined. 4th, The ramming hammer."

5. For an *Improved Magazine Repeating and Needle Gun;* Edward Lindner, City of New York; patented June 27, 1854; re-issued (on division,) Dec. 23, 1856.

Claim.—"The combination of the igniting needle with the revolving cylinder, or breech-piece, when constructed, arranged, and operated in such a manner that the needle can only be projected when the proper aperture is presented to it, and will always be withdrawn previous to the revolution of the cylinder."

6. For an *Improvement in Manufacturing Carpets;* John G. Macnair, Norwich, Conn.; patented August 7, 1852; re-issued December 23, 1856.

Claim.—"The fabric produced by the double wefts, one or both of which are particolored, in combination with the two sets of warps—one to divide and ingrain the wefts, and the other to bind in the wefts."

7. For a *Multiform Moulding Plane;* Thomas D. Worrall, Assignee (through Mifflin Paul) of Thomas Worrall, Lowell, Mass.; patented August 29, 1854; re-issued December 23, 1856.

Claim.—"The combination of a separate moulding part or slide, with the handle supporting part or body of the plane, and applied thereto by means of plates and screws, or equivalent devices, for the purpose not only of enabling it to be removed from said handle part or body, but to allow another such a slide (provided with a plane iron or cutter), whatever may be its pattern, to be used in the application of, or in combination with, such handle part, or body, as circumstances may require."

8. For an *Improved Machine for Reaming and Tapping Gas Fittings;* Henry A. Chapin, Springfield, Massachusetts; patented July 1, 1856; re-issued December 23, 1856.

Claim.—"The combination of the tool-holder with its spindle, when the said tool-holder is armed with its complement of bits or tools, and is capable of being turned upon an axis at right angles to, and independent of, the axis of the spindle, so that either tool may be revolved in the axis of the spindle. Also, the rotary tool-holder as constructed and operating in combination with the revolving chuck or clamp, for holding the fitting."

DESIGNS FOR DECEMBER, 1856.

1. For *Printing Types;* George Bruce, Albany, New York; December 2, 1856.

Claim.—"I call this new type, double small pica copper-plate script, and I claim the design."

2. For *Cooking Stoves;* Samuel W. Gibbs, Albany, Assignor to A. H. McArthur & Co., Hudson, New York; December 9, 1856.

Claim.—"The combination and arrangement of ornamental figures and forms, forming together the ornamental design for the plates of an elevated oven cooking stove."

3. For *Cooking Stoves;* S. W. Gibbs, Albany, New York, Assignor to G. W. Ball & Co., Cincinnati, Ohio; December 23, 1856.

Claim.—"The combination and arrangement of ornamental figures and forms, forming the ornamental design for the plates of a cooking stove."

4. For *Cooking Stoves;* Garrettson Smith and Henry Brown, Philadelphia, Penna.; December 23, 1856.

Claim.—"The design, configuration, and arrangement in bas-relief on the several plates, constituting stove design 'Young American.'"

5. For *Parlor Grates;* John T. Davy, Troy, New York; December 23, 1856.

Claim.—"The ornamental configuration and design for a parlor stove grate."

6. For *Cooking Stoves;* John T. Davy, Troy, New York; December 23, 1856.

Claim.—"The ornamental configuration and design for cook stove plates."

7. For *Parlor Cooking Stove;* John T. Davy, Troy, New York; December 23, 1856.

Claim.—"The ornamental design and configuration of parlor cook stove plates."

8. For *Metallic Bedsteads;* John B. Wickersham, City of New York; December 23, 1856.

Claim.—"The ornamental design of the post, leg, and head-board of the bedstead."

9. For *Floor Cloths;* Antoine Glominski, Assignor to Deborah, A. E., and Nathaniel B. Powers, Lansingburgh, New York; December 23, 1856.

Claim.—"The arrangement of ornamental figures, forming a design for floor oil cloths, or other fabrics."

JANUARY 6, 1857.

1. For an *Improvement in Door Springs;* John Broughton, Chicago, Illinois.

Claim.—" Combining a flat or other suitable spring, with the leaves of the auxiliary hinge, or other actuating devices, by means of a compound or double-action toggle."

2. For an *Improvement in Grinding Mill;* James Culbertson, Covington, Ky.

Claim.—" The combination of the long feeding channels in the grinding surface of the burr, with the discharging channels situated in position just preceding the feeding channels in the revolution of the burr."

3. For an *Improved Cross-cut Sawing Machine;* Wm. Cady, Eaton, Ohio.

Claim.—" The connecting rod, vibrating lever, bar, lever, provided and connected with the saw, cord, lever, catch, and brake."

4. For an *Improvement in Bullet Moulds;* Tristram Campbell and Henry B. Poorman, St. Louis, Missouri.

Claim.—" The mechanical arrangement of the 'trough knife,' with the lever, draw-bar, and springs."

5. For an *Improvement in Bosom Studs;* J. Perley Derby, Boston, Massachusetts.

Claim.—" A stem, to which is attached a slide, constructed with a slot and spring in the same, which, on being inserted through the holes of the garment, which it is intended to secure (be it shirt bosom or other parts of the apparel), can be moved or pushed as far as required, and there secured by the force of the spring before named."

6. For an *Improved Fire Hook;* John G. Ernst, Harrisburgh, Penna.

Claim.—" The hook, constructed of the two parts, and attached to the beam, which is provided with rounds, and mounted upon wheels."

7. For an *Improved Method of Applying Filters to Supply-pipes;* James Fernald, Boston, Massachusetts.

Claim.—" The combination with the main water pipe of a house, of a filter, an auxiliary pipe, and a waste pipe—the pipes being provided with cocks."

8. For an *Improved Machine for Upsetting Tire;* Russell W. Gates, Homer, Mich.

Claim.—" The use of the right and left threaded screw shaft, operated in connexion with the blocks."

9. For an *Improved Mortising Machine;* Charles Green, Bethel, Ohio.

Claim.—" The combination of the frame, or bar, with its slot, the ⊤ shaped bars or pieces, with their slots, slotted frames, or beds, pivoted in the rear to the bars, and carrying the revolving chisel, arbors, or axles, slotted and double arms, or connecting rods, and slotted driving arm, all arranged for operation together for the easy adjustment and simultaneous production, when desired, of different sized mortises in the one stick, and at varying distances apart."

10. For an *Improvement in Velocimeters for Vessels;* Andrew B. Gray and Alexander H. Brown, Washington, D. C.

Claim.—" The use of the adjustable paddle wheel, which can be graduated to any number of revolutions by presenting more or less surface of paddle to the action of the water, in order, first, to fix it at its true point for registering correctly ; and, second, should any wear take place in the machinery for registering, it can at once be adjusted by changing the angle of the paddle."

11. For an *Improved Rotary Shears;* Anson Hardy, Dorchester, Massachusetts.

Claim.—" Dispensing with the top beam, or support, as commonly used, and supporting the carriage on the lower beam, to which the straight knife is attached, by which means I avoid the expense of, and objection to, a top beam. Also, the use of the revolving circular knife, when operated by two or more gears, that can be regulated so as to give any amount of drawing cut that may be required."

12. For an *Improvement in the Manufacture of Animal Traps;* C. Jillson, Worcester, Massachusetts.

Claim.—" A new manufacture of animal traps."

13. For an *Improvement in Traveling Trunks;* Henry Loewenberg, City of N. York.

Claim.—"The combination of the folding portions with the grooves and tongues, and the fastenings to make an extensible trunk."

14 For an *Improvement in Forming Joints for Sheet Metal;* J. J. Laubach, Easton, Pennsylvania.

Claim.—"The roller attached to the pendent and swinging bar, which is connected or jointed to the arm."

15. For an *Improvement in Hats;* Evan Morris, Philadelphia, Pennsylvania.

Claim.—"Cutting or slotting the 'band' of a hat to make that part of it soft and yielding to the head—whilst at the same time it is made to retain the requisite stiffness and support to give it durability."

16. For an *Improved Method of Adjusting Circular Saws to any required Disk;* Josiah B. Pomroy, Chicago, Illinois.

Claim.—"Combining the concave cheeks, set screws, with a circular saw which has a slit (or slits) extending outwards a short distance from its inner periphery, at the same time that the said saw has an undivided outer periphery."

17. For an *Improvement in Folding Umbrellas;* L. K. Selden, Haddam, Conn.

Claim.—"The braces connected by pivots, and attached by pivots to the ribs, stretchers, and handle."

18. For an *Improved Weather Strap, for Doors, Windows, &c.;* James Smith, Cleveland, Ohio.

Claim.—"In combination with a weather strip hung to its springs, a jointed rod and set screw for operating it, when said rod is made to press down the strip at one point only; and this I claim, whether the strip be arranged in the door, or in or under a shield on the door, or both."

19. For an *Improved Raking Attachment for Reapers;* James H. Thompson, Newark, New Jersey.

Claim.—"The vibrating and intermittently rotating shaft, when fitted or placed in the bar, and provided with teeth, and operated by the wheel, hubs, pawls, cranks, and connecting rod."

20. For an *Improvement in Cross-ties and Chairs for Railroads as a New Manufacture;* Andrew Teal, Aurora, Illinois.

Claim.—"My improved adjustable double chair, for supporting the rails of railways, and at the same time securing said rails in any desired position—the said double chair being composed of T shaped metallic rails of suitable length, combined with duplicate pairs of transversely grooved clamping blocks."

21. For an *Improvement in Maintaining Power for Time-Pieces;* James Tuorlinge, City of New York.

Claim.—"The fixed screw or circular incline carrying the weight, combined with the rod, or their equivalents, for communicating the motion and power from the said revolving weight to the wheel. Also, the retaining spring on the weight, combined with the fork and fingers, or their equivalents, that will lift the weight up bodily, and allow said retaining power to act."

22. For an *Improvement in Riding Saddles;* Seth Ward, Princeton, Indiana.

Claim.—"The application of an india rubber spring to the back part of the cantle, secured above and also below the semicircular opening of the cantle, by screw-plates, let in for the purpose of obviating the necessity for any springs, either under the seat or cantle, it in itself giving sufficient elasticity to the seat."

23. For an *Improved Self-regulating Wind Director for Wind-Mills;* Henry S. Wentworth, Napoleon, Michigan.

Claim.—"A semicircular revolving balance screen, operated variably by the power of the wind upon the revolving extra fan, for the purpose of admitting only the requisite current of air to the wheel, whether placed in a horizontal or vertical form."

24. For an *Improvement in Buckles;* George P. Woodruff, Watertown, Conn.

Claim.—"Constructing and combining together the bow and the tongue of a buckle in such manner that the strap is secured between the two, at the hinge of the buckle."

25. For an *Improvement in Air Heating Furnaces;* Joseph D. Greene and Edward Ivers, Assignors to Joseph D. Greene, Philadelphia, Penna.

Claim.—"The peculiar arrangement of the double series of smoke conducting and air heating tubes, with the other parts of our air heating apparatus, viz: the series of smoke conducting tubes being arranged around the exterior surface of the furnace chamber with their induction smallest ends uppermost, and the series of air heating tubes being arranged around the interior surface of the furnace chamber, with their induction smallest ends opening downwards, and both ends open to the atmosphere."

26. For an *Improvement in Ships' Cooking Stoves;* Daniel S. Beardsley, Assignor to self and John D. Umberfield, New Haven, Connecticut.

Claim.—"Hanging a stove to be used on ship board, by means of the hollow pivots and flue, so that the stove shall always maintain an upright position, and the draft not be interrupted."

27. For an *Improvement in Extension Tables;* Benjamin Clark, Assignor to E. L. Ferguson and C. B. Clark, Oriskany Falls, New York.

Claim.—"The combination of the fixed side pieces, with the table leaves and table legs—the side pieces serving the double purpose of holding the table firmly together, when compacted and closed, and also serving in conjunction with pieces to give stability to the frame, when the same is opened or extended."

28. For an *Improvement in Valves for Steam Engines;* Cornall Bradley, Manchester, Virginia.

Claim.—"The making the valves of steam engines with two surfaces—one being exposed to the action of the steam downwards against the valve seat—the other surface exerting a contrary pressure into the chamber—the inside of said chamber being in communication with the atmosphere."

29 For an *Improvement in Rudders;* A. B. Crossman, Huntington, New York.

Claim.—"The attachment to the rudder, of an extension piece, when the said extension piece is so combined and employed as to render the rudder wholly or partially self-balancing."

30 For an *Improvement in Carriages;* John W. Crannell, Olivet, Michigan.

Claim.—"The mode of constructing the carriage body in two parts, the inner ends chamfered or rounded below said bodies, being attached to two elastic bars, in combination with the independent seat frame, and carrying inside two springs, or their equivalents, in either a horizontal or vertical position, but whose action is horizontal and against the chamfered and detached ends of the carriage bodies, for the purpose of producing a gentle and undulating horizontal movement in the seat. Also, the use of the stop plates, operated by screws, or otherwise, for the purpose of regulating the elasticity of the springs."

31 For an *Improvement in Looms;* François Durand, Paris, France.

Claim.—"1st, The combination with a stationary race way, of a reed, passing entirely through the same. 2d, The weft thread needles, controlled by a jacquard machine, or other pattern mechanism, to operate upon the weft threads, in combination with a thread carrier. 3d, The unhooker, operating in combination with the thread carrier."

32. For an *Improvement in Tanning Hides;* Edwin Daniels, Lafayette, Wisconsin.

Claim.—"The use of saltpetre, alum, and sulphuric acid, respectively, in solution of catechu, or other substance containing an equivalent amount of tannin."

33. For an *Improvement in Anchors;* Thomas L. Dalton, City of New York.

Claim.—"An anchor."

34. For an *Improved Mode of Constructing Stalls for Horses;* Henry Eddy, North Bridgewater, Massachusetts.

Claim.—"A crib or manger, with the inclined planes. Also, the space partially inclosed by the inclined planes, with a vertical opening."

35. For an *Improvement in Operating Slide Valves for Steam Engines;* Robert H. Fletcher, Brooklyn, New York.

Claim.—"The arrangement of the slide valve and stem, with their operative parts within the steam chest, so that they may be operated from the piston head within the steam cylinder."

36. For an *Improvement in Instruments for Measuring Boards;* James Jones, Rochester, New York.

Claim.—"My means of so adapting the instrument, that it may be applied to the actual surface—whether of a board or other article—such means consisting of the outer and inner disks, combined with the two indices, one of said indices being intended to regulate the position of the friction roller on the inner disk, and the other for indicating the quantity measured."

37. For an *Improvement in Artificial Legs;* Benjamin W. Jewett, Gilford, N. H.

Claim.—"1st, The spiral spring, in combination with the rod, hook, and cross brace. 2d, The method of attaching the tendo-achilles and the cord to the thigh, by the use of the pins. 3d, The bolts, in combination with the straps and their metallic boxes."

38. For an *Improvement in Milking Shields;* Orwell H. Needham, City of N. York.

Claim.—"Combining the perforated band or ring, or its equivalent, with the yielding lining whereby an inward pressure against the teat, or nipple, is produced—the point of said pressure being changeable at pleasure."

39. For an *Improvement in Processes for Reducing Zinc Ores;* Samuel Wetherill, Bethlehem, Pennsylvania.

Claim.—"Causing the metallic vapors of zinc, driven off from the ore by heat, to pass through a charge of heated or incandescent coal, or other carbonaceous matter."

40. For an *Improvement in Making Cop Tubes;* Nathaniel Whitmore, Assignor to self, Somerville, and G. W. Keene, Lynn, Massachusetts.

Claim.—"The tube with its backing, in combination with the spindle. Also, the tubular step for the support of the tube while it is being flanched, in combination with the receiver."

41. For an *Improvement in Cultivator Teeth;* James P. Cramer, Assignor to Hiram Cramer, Schuylerville, New York.

Claim.—"My improved tooth, composed of a properly shaped sheet metal blade and shank, with an iron head cast upon the shank, and embracing its outer and inner surfaces in such a manner that the said blade, shank, and head of the tooth will form but a single piece."

42. For an *Improvement in Hemp Brakes;* Samuel H. Little, St. Louis, Missouri.

Claim.—"Placing the feeding rollers and the throat bars in one and the same movable frame, for the purpose of enabling said frame to be so adjusted as to give any desired space between said throat bars and the beating bars of the reciprocating gate, without varying the distance between said feeding rollers and the throat bars. Also, securing the throat bars within their supporting frame, in such a manner that they can be so adjusted as to form a wider or a narrower opening to the reception of hemp stalks of different sizes; but this I only claim, when the said throat bar supporting frame is so arranged in relation to the supporting frame of the reciprocating gate, that their distance from each other can be so adjusted that the action of the beaters will be exactly adapted to the size, quantity, and condition of the hemp stalks fed through said throat. Also, the combination of the shaking shoe with the reciprocating gate."

43. For an *Improvement in Pumps;* G. W. B. Gedney, City of New York.

Claim.—"The working leaf valve, or four-way cock, arranged with respect to the two cylinders and solid pistons, so as to give a more direct and unobstructed course to the water, than is obtained in the slide valve pump, patented by Webster."

MECHANICS, PHYSICS, AND CHEMISTRY.

Notes on the Progress of Engineering, &c.[*]

Southampton, November 24th, 1856.

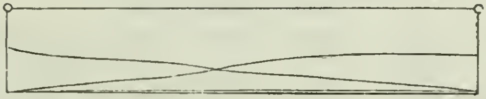
The United States steam frigate *Merrimac* sailed from here on the 29th ult., having had her defective foot-valves in air pumps replaced by new ones, with larger area through the gratings, the old valve-seats having 176 sq. in., and the new ones 230 sq. in. for each foot-valve, as mentioned in our last number.

We have been favored by Mr. Long, the chief engineer, with the result obtained by this increase, viz: in one engine 2 in., and in the other 1½ ins. more vacuum in the condensers.

By a friction diagram taken from these engines, with the screw disconnected (that is, *hoisted*), and the vessel at anchor, the H. P. absorbed in friction alone appears to equal 71 H. P.; but of course this amount would be greater when the whole pressure of steam is admitted to the engines for propelling the vessel: in other words, the friction of the machinery, when *loaded*, would of course exceed the friction when the diagrams were taken. The actual amount of the increased friction of the load cannot, of course, be measured by the indicator, and must be a constantly varying quantity; but Mr. McNaught estimates it at $\frac{1}{20}$th of the increased pressure upon the piston. The diagrams below are accurate copies of those obtained from the *Merrimac* under the before-mentioned circumstances. It will be observed that the revolutions, at the time the diagrams were taken, were only 40 per min., whereas the average revolutions at sea are about 45 per min.; but we think that the chief engineer exercised commendable caution in not allowing his engines to run too quick, as it is a delicate operation to try experiments on large engines when unloaded. We remember one instance in which the cylinder of a large paddle engine was split whilst running without the floats.

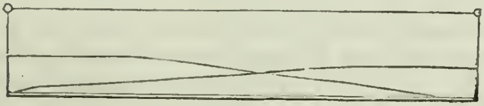
MERRIMAC, "C," H. P. = 70·7

Friction Diagram, Forward Engine, October 23, 1856.
Revolutions, 40. Average Pressure, 2·39.



MERRIMAC, H. P. = 72·7.

Friction Diagram, After Engine, October 23, 1856.
Revolutions, 40. Average Pressure, 2·46.



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[*] From the Lond. Artizan, Dec., 1856.

The Peninsular and Oriental Company's screw steam ship *Simla* sailed, with the mails on board, on the 12th inst. for Sydney. She has been chartered for two years, by the European and Australian Royal Mail Company, and will run in conjunction with the *Oneida* and *European* from Sydney to Suez. The *Simla* is a very fine vessel, and has performed admirably during her long engagement in the transport service; one of her runs, viz., from Plymouth to Malta Harbour, in 6 days 20 hours, a distance of 2012 knots, has never been surpassed. She was built in Hull, and machinery by Messrs. Tod & McGregor of Glasgow, in 1854; has geared engines, the multiple being 110 to 37.

Diameter of cylinder, . . .	90 ins.
Stroke of pistons, . . .	6 ft. 6 "

Each piston has four rods, with the ordinary steeple motion. Screw propeller has three blades; diameter, 17 ft. 6 ins.; pitch, 23 ft., and uniform.

The boilers, four in number, are on Messrs. Lamb & Sumner's patent flue principle, and have produced very economical results, the consumption of coal at sea, being only 3·8 lbs. per indicated H. P. per hour.

The *Simla* was tried at the measured mile in Stoke's Bay on the 7th inst., a great number of scientific and commercial gentlemen interested in steam navigation being present. She was very deeply laden, having on board all her coal, stores, &c., for the voyage to Australia.

Her draft forward was	21·6	20 ft. 10½ ins. mean draft.
" aft "	20·3	

	Tons.	
Coal on board	1460	Total dead weight on board = 1860 tons.
Water "	60	
Spare gear, &c.	40	
Stores and Cargo	300	

Immersed midship section, ... 648 sq. ft.

Log on Measured Mile.

Mile.	Time. M. Sec.	Speed.	Revs.	Steam. lbs.	Vacuum. ins.
1st, ...	4·42	12·776	19½	15½	26
2d, ...	5·25	11·077	19	15	26

Mean Speed	= 11·921	knots per hour.
Speed of Screw	13·	" "
Slip of "	1·1	"
Do. per cent . .	= 9.	
Coefficient of immersed midship section, . .	623 sq. ft.	

This trial was made, as will be observed, under the disadvantages of great immersion, and from the draft forward exceeding that aft; but this will be remedied as she proceeds on her voyage, and her coals are consumed, chiefly from the forepart of the centre of gravity of the vessel, which will lighten her more quickly forward than aft. She was tried June 28, 1854, on her arrival from Scotland, at the same measured mile, her draft being 18 ft. forward, and 17 ft. aft; immersed midship section =517 sq. ft., when her mean speed was 13·35 knots per hour.

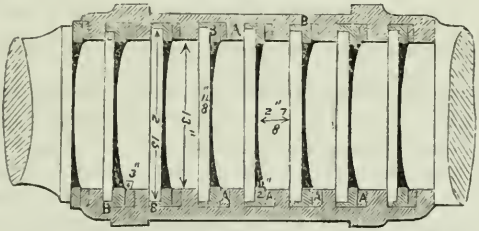
The *Oneida*, which sailed from here on the 19th ult. for Sydney, arrived at St. Vincents on the 28th, after a fine run of nine days six hours; the distance is 2350 knots.

H. M. S. *Himalaya* is still at Plymouth, uncommissioned. We understand that the Government engineers are so satisfied with the plan adopted by Gray, her late engineer, for the repair of her thrusting-block, that they have had the length of shafting which contains the thrusting-collars put into a lathe in the steam factory, and thoroughly carried out his plan, by turning the collars down to a true surface, and pinning brass rings, in halves, on to their thrusting surfaces. By this means the new brass rings will thrust against the lignum vitæ segments, whereas, before this alteration, the roughened iron collars formed the rubbing surface in contact with them. We mentioned in a former number that the idea of fitting these lignum vitæ segments occurred to Mr. Gray, in consequence of the rapid wear of the brass rings in the *Himalaya's* thrust-block; and we are pleased to be able to add that this simple method of quickly and cheaply renewing the thrusting surfaces of these blocks, is likely to be adopted in other government steamers, where the same difficulties have occurred. Mr. Gray has received the thanks of the commander of the *Himalaya*, Captain Priest, and also the expression of satisfaction from the Admiralty. We should like to hear of some more solid proof of their Lordship's appreciation of Mr. Gray's services.

Plan of Thrust-collars and Bearing, *Himalaya*.

Scale, 1½ in. = 1 ft.

A, A, A, are the lignum vitæ segments; B, B, the new brass rings.



By the subjoined sketch our readers will perceive that the thrusting surface in the *Himalaya's* thrust-block, has been increased from 496 sq. ins., as before the alteration, to 571 sq. ins. We may add that it is a very important item to the success of wood bearings that their surfaces shall be thoroughly lubricated; in the present case this is effected by scoring the surface of the brass rings with *races*, which allows the water to circulate freely on all parts of the collars. We believe that water must be allowed to flow on all wood bearings of this nature, as the small quantity of oil which could be allowed for lubrication, would not be sufficient to carry off the heat caused by friction.

The Belgian and New York screw steamship, *Leopold II.*, has just arrived here for the purpose of being docked for survey by Lloyd's Agents. She was built and fitted with machinery by the Cockerill Company, of Belgium, and is reputed to be a fast ship. She is about 1800 tons burden, with inverted cylinder engines of 340 nominal H. P.

Diameter of cylinders, . . .		60 ins.
Stroke of piston, ...		4 ft.
Revolutions per minute, average,	35.	
Nominal H. P. at above revolutions,	336.	

Her engines have each two piston rods, the air pumps being worked by beams from the cylinder cross-heads, and so assisting to balance the weight of piston and connecting-rods.

There is also a large balance wheel keyed on to the crank shaft, which answers for turning engines by hand, and in some degree as a fly-wheel.

The screw is three-bladed, and projects beyond the after stern-post, as in Beattie's patent, the rudder being enclosed in the space between the two stern-posts, and the screw shaft dividing it in two pieces, which are connected by an oval looped rudder post. The screw is 18 feet diameter, and 36 feet pitch, so that with 35 revolutions of engines, the speed of screw equals 12·4 knots per hour; and, as the diameter is so very large (for the power transmitted through it) there is, of course, but little slip.

The tubular boilers have twelve furnaces, 3·8 wide, and 7 ft. long; thus giving 308 sq. ft. of grate surface; the tubes, 290 in number, are 7 ft. long, and 3¼ outside diameter. We hope to give some particulars of this vessel in our next.

The *Belgique*, belonging to the same Company, which sailed from here for New York last month, arrived at that port after a run of nineteen days, having met with very strong head winds the whole way across.

On Electrical Conduction in Submarine Cables.[*] By WILLIAM THOMSON.

There are some conclusions from my theory of electrical conduction in submarine cables which, if correct, must be found valuable in planning the best dimensions and arrangement of wires and insulating tubes for telegraphic communication between Britain and America:—an undertaking at present actually in progress, as appears from statements in the *Athenæum.* It is, therefore, of importance that such of your readers as may be interested in the subject should, without delay, have some evidence to allow them to judge as to the validity of the objections to those conclusions which Mr. Wildman Whitehouse made in his communication to the British Association at Cheltenham (reported *Athen.* August 30,) and which he still maintains in his letter recently addressed to you (*Athen.* Oct. 11,) notwithstanding my confident assertion of their correctness and my reference to the theoretical demonstration (*Proceedings of the Royal Society*, May 10, 1855, and *Philosophical Magazine*, vol. Jan. to June, 1856,) as supporting this assertion by unassailable evidence (*Athen.* Oct. 4). On this account, rather than from any desire to continue in your columns a controversy which I believe will be easily adjusted by private correspondence, I offer you the following remarks.

The points of greatest practical importance in my conclusions are, 1, "the law of squares," as it has been called by Mr. W. Whitehouse; and, 2, the influence of lateral dimensions of wire and insulating coat on the rapidity of signals by a submarine cable of stated length. It is on these points chiefly that Mr. W. Whitehouse brings his attack, and it is to these that I shall confine my present defence.

[*] From the Lond. Athenæum, November, 1856.

1. *Law of Squares.*—In his Cheltenham communication, Mr. W. Whitehouse brings forward the following table of results, as conclusive against the law of squares:—

Amount of Retardation observed at various Distances. Voltaic Current. Time stated in Parts of a Second.

Mean of 550 obsrvns.	Mean of 110 obsrvns.	Mean of 1840 obsrvns.	Mean of 1960 obsrvns.	Mean of 120 simultaneous observations.	
83 miles.	166 miles.	249 miles.	498 miles.	535 miles.	1020 miles.
·08	·14	·36	·79	·74	1·42

The retardation here shown as the results of undoubtedly trustworthy observations, are not proportional to the squares of the distances; but it depends on the nature of the electric operation performed at one extremity of the wire, and on the nature of the test afforded by the indicating instrument at the other extremity, whether or not any *approach to the law of squares is to be expected* in the observed results. Thus, the following table, which I have derived solely from theory,* shows for different lengths of cable, of certain lateral dimensions, the delays, from the instants of beginning various definitely specified electrical operations at one extremity experienced in waiting for the indications by each of two definite tests of electrical effect at the other extremity:—

	150 miles.		300 miles.		600 miles.		1200 miles.		2400 miles.	
Durations of battery action.	Times from beginning of battery-action till strength of current rises to									
	¾ max.	max.	¾ max.	max.	¾ max.	max	¾ max.	max.	¾ max.	max.
seconds	seconds.	seconds.	seconds.	seconds.	seconds.	seconds.	seconds.	seconds.	seconds.	seconds.
·0	·011	·0164	·044	·0656	·175	·2622	·7	1·049	2·8	4·196
·333	·0378	·333	·145	·354	·353	·49	·84	1·17	2·93	4·27
·667	·0378	·667	·151	·667	·495	·78	1·08	1·45	3·07	4·4
1·000	·0378	1·000	·151	1·000	·564	1·104	1·25	1·70	3·20	4·53
8·	·0378	8·000	·151	8·000	·604	8·000	2·416	8·33	6·93	10·
16·	·0378	16·000	·151	16·000	·604	16·000	2·416	16·00	9·00	17·47
24·	·0378	24·000	·151	24·000	·604	24 000	2·416	24·00	9·60	25·33
∞	·0378	∞	·151	∞	·604	∞	2·416	∞	9·664	∞

The electrical operation to which the first horizontal series of numbers in the table refers is in strictness an infinitely short application of an infinitely intense electro-motive force; but, practically this condition will be realized to a sufficient degree of approximation for verifying the result by applying a powerful battery or an electro-magnetic impulse during one-twentieth, or any smaller fraction of the time, shown as the delay of the maximum in each case,—for instance, during $\frac{1}{1200}$ of a second, or any less time, for the 150-mile cable, or during $\frac{1}{5}$th of a second or any less time for the cable of 2400 miles. The electrical operations referred to in the other horizontal lines consist of applications of one pole of a constant battery during the stated times. In every case the extremity operated on is supposed to be put in connexion with the earth at the instant when it is disconnected from the battery. The other extremity is supposed to be always kept in connexion with the earth. The conductor of the indicating instrument through which this connexion is established is supposed to exercise but a small resistance compared with that of any number of miles of the wire, and is assumed to give rise, by electro-magnetic induction, to no delay comparable with that due to the induction of the other kind (peristaltic induction) in the cable in each case. This last condition will be far from being fulfilled, except for the longest cable, when large coils with soft iron cores are used in the indicating instrument, as any one will be ready to admit who has seen Faraday's beautiful magneto-optical experiment, and has remarked the gradually rising illumination consequent on the sudden completion of the voltaic circuit.

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* I have obtained the tabulated results merely by inspection from a diagram of curves published with my first communication to the Royal Society on the subject. The decimals will, no doubt, require some correction when exact calculations are made, as will very soon be the case. The lateral dimensions for which the table has been calculated are those of a single wire cable, copper wire ·065 in. diameter, gutta purcha tube $\frac{1}{4}$-in. outer diameter.

Now, it will be observed that the law of squares is fulfilled throughout no horizontal line of the table, except the first and the last. If, for instance, we take the series of retardations of $\frac{3}{4}$ of maximum strength, and of maximum strength consequent on an application of the battery for one-third of a second, we have the following comparative view :—

Lengths, . .	150	300	600	1200	2400
Retardation of $\frac{3}{4}$ maximum, .	·0378	·145	·352	·84	2·93
Retardations of maximum, . .	·333	·354	·49	1·17	4·27

Here the retardation of the $\frac{3}{4}$ maximum is a little short of four times as much in the 300 mile cable as in the 150; it is only $2\frac{1}{2}$ times as much in the 600 as in the 300; only $2\frac{1}{4}$ times as much in the 1200 as in the 600; and only $3\frac{1}{2}$ times as much in the 2400 as in the 1200; instead of being 4 times greater in each of the longer cables than in the other of half-length, as it would be if the law of squares were applicable.

By comparing, on the same principle, Mr. W. Whitehouse's results quoted above (*Athen.* Aug. 30, p. 1093), we find very analogous *deviations from the law of squares;* but for a strict verification of their *agreement with theory*, it would be necessary to have a precise specification of the electrical operations which were performed at one extremity, and of the exact nature of the test of electrical effect afforded by the receiving instrument at the other extremity. The manuscript of the Cheltenham paper, to which, through the courtesy of Mr. Whitehouse, I have had access, shows that the operations were *certainly not such as could give effects on the whole manifesting the law of squares even approximately*, and makes me think it probable that electro-magnetic induction in the receiving instrument has most sensibly influenced the retardations observed with the shorter lengths of cable, increasing, relatively, those observed with the shortest. Each application of the battery appears to have been maintained for a second, and, therefore, whether this was instantly followed by a reverse application (as appears to have been the case), or by the establishment of a connexion with the ground, the law of squares ought to be verified very closely for all lengths of cable less than 300 miles, if the battery power is arranged so that the maximum strength of the current is in all cases the same. Accordingly, we have a tolerable verification of the law of squares by Mr. Whitehouse's observed retardations in the 166 mile and the 249 mile cable, which are respectively ·14 and ·36. These show an even greater increase of retardation in the greater length than according to that law, which would have been exactly verified by the numbers ·14 and ·315. If the indicating instrument does not show its effect until a somewhat larger proportion than $\frac{3}{4}$ of the maximum strength is reached, the retardation in 498 miles may be either more or less than twice the retardation in 249 miles; and if it be only little more than twice (being ·79 as Mr. Whitehouse finds it), it will follow from the theory as illustrated by the table that the retardation in 996 miles ought to be found considerably less than twice the retardation in 498. Thus Mr. Whitehouse finds even the retardation in 1020 miles less than the double of the retardation which he finds in 498 miles. Another cause which may contribute to deviations from the law of squares, and which must most seriously derange the results from agreement with any easily calculated indications of theory, is the inconstancy of the galvanic battery employed. It is well known to all who have used the sand-battery, or any other form of battery which evolves gaseous hydrogen during its continuous action, that, in commencing to act after having been quiescent for any time, it acts with immensely greater electro-motive force than it can keep up, and that during the initial second of its operation the electro-motive force *falls in general with great rapidity.* This circumstance it is probable, largely influences the phenomena which Mr. Whitehouse observed; and if it does, must complicate extremely the character, both relative and absolute, of the electrical operations used in his experiments on different lengths of cable.

It appears then, that in the one case of comparison in which a manifestation of the law of squares could be expected, that law is manifested by Mr. Whitehouse's results, and that in all other cases, so far as the data supplied suffice for testing, they agree with the theory of which the law of squares is a part.

To test the theory extensively and strictly by observations with Mr. Whitehouse's instruments will, probably, not be easy without using either a constant battery or a system of measured electro-magnetic impulses. It will, however, I have no doubt, be quite practicable with a sufficient number of cells of Daniell's battery to verify the law of squares with considerable precision for lengths of cable from 498 miles upwards. All that will be necessary will be to take such battery powers as to give the same permanent current through the cable and instrument in the different cases, that is to say, to make the numbers of cells used proportional to the lengths of the cable; and in each experiment to hold on the battery connexion until after the indicating instrument has made its mark. The most favorable relation between the sensitiveness of the indicator and the battery power, to give a sharp test, is such that the full strength of the permanent current is about four times the strength that just moves the index. But this would probably give too small a retardation in the 498 mile cable to free the comparison from large influence of electro-magnetic induction in the coils, and it may be that a more satisfactory test would be obtained with the actual instruments, by using battery power capable of maintaining a permanent current more by only ⅓d or ¼th than enough to give an indication.

2. *Influence of Lateral Dimensions of Conductor and Insulating Tube on Rapidity of Electrical Action.*—My remedy for inconvenient slowness of action in a submarine cable is an increased diameter of conductor and of gutta percha coat, in the same proportions, or in different proportions, indicated by economical considerations calculable from theory with data as to the price of copper, gutta percha, and iron, and the relative expense and risk in laying cables of different weights (see my first communication on the subject referred to above). Until the price of copper comes to be a serious consideration in comparison with the whole expense of making and laying the cable, an increase in the diameter of the conductor alone, up to a certain limit, without any increase in the thickness of the gutta percha tube, may be the cheapest remedy. Accordingly, in my statement quoted by Mr. Whitehouse, either on thick copper wire, or (as is preferable for mechanical reasons) "a number of small wires twisted together" is recommended to obviate inconvenient slowness of utterance. Mr. Whitehouse tests this proposal by three wires connected at their ends so as to afford a tripple conducting channel, *but separated throughout their lengths by their gutta percha coats.* Now it is perfectly clear that an electrical impulse through three wires so arranged cannot differ from the sum of three separate electrical impulses of one-third strength each through any one of the wires, except in virtue of mutual peristaltic induction. With these very wires Mr. Whitehouse found the effects of mutual peristaltic induction to be extremely slight, requiring some of his finest tests to be shown at all. How then he found "the retardation nearly twice as great with the triple wire as in one of the wires alone," is an anomaly which it is not my part to explain. I may be allowed to suggest as a possible explanation, that he used only battery power enough to give the same permanent current through the triple wire as through the single wire in the comparative experiments, and that the triple conductor exhausted the high initial electro-motive force much more rapidly during the first quarter of a second than the single wire. In reality, when justice is done to the triple wire, it will be found to transmit the action *a very little more rapidly than one wire alone;* in consequence of the diminution of electrostatic capacity in each wire, which is caused by mutual induction among the three when equal neighboring parts of them are similarly and equally electrified at each instant. But my law regarding the effect of increasing the diameter of one wire or of using *a number of fine wires twisted together*, is neither proved nor disproved by experiments on the combined effects of a number of wires about as widely separated from one another as from their common iron sheath.

Neither on the two points to which I have especially adverted, nor on any other, will it be possible, I believe, to find the theory at fault; and Mr. Whitehouse has too effectively proved himself to be a sincere searcher for truth to allow me to doubt that he will sooner or later fully admit the correctness of my conclusions, although they have hitherto appeared to him to be at variance with the phenomena he has observed.

On the other hand, I have much pleasure in admitting that he has quite answered my objections to experiments on the retardation of effects of a current sent through a certain length of wire backwards and forwards in a "multiple" cable, as trustworthy for indicating the retardations to be expected in the same length of wire laid out singly to an untried distance. I am very glad, too, to perceive that he has succeeded in convincing practical men by his experiments, in conjunction with Mr. Bright and Mr. Morse, that a cable of ordinary lateral dimensions may be not too slow in its action for commercial success in the projected sub-Atlantic telegraph.

I should certainly not have expected that this would be found to be the case *if the Varna and Balaclava telegraph, when pushed to the utmost, had been found to be inconveniently slow;* but although I have never been able to learn any particulars as to the experience of those who have worked that telegraph, I have the best possible reason now for knowing that if nine letters per second have not been delivered by it, the fault, or rather I should say the deficiency, has not been in the cable, but in the instruments. Measurements published since the beginning of the present year by that most profound and accurate of all experimenters, Wilhelm Weber, have allowed me to reduce his own previous determination of the electrical conductivity of copper to the proper kind of unit for the telegraph problem, and have so afforded me the data for calculating the retardations of electric signals sent through a copper wire of stated dimensions, insulated in any specified manner. I thus find that the retardation of the maximum strength at one extremity, consequent on a single instantaneous electrical impulse at the other extremity of 400 miles of Black Sea cable,* amounts to only about ·117 of a second. The corresponding retardation in a cable of equal lateral dimensions, and 2400 miles long, would be only about 4·2 sec. A mode of operating so as to clear a wire rapidly of residual electricity, which I have worked out from theory, and a plan for telegraphic receiving instruments to take the most full advantage of it which has recently occurred to me, allow me now to feel confident of the possibility of sending a distinct letter every $3\frac{1}{2}$ seconds by such a cable. This, amounting to 17 letters per minute, would give 200 messages of twenty words in the 24 hours, and at 30s. a message would be not a bad return for 1,000,000 *l.* of capital expended. The rate could be augmented to a letter every $2\frac{1}{4}$ seconds, or 280 messages in 24 hours, by augmenting the diameter of copper and gutta percha tube each in the proportion of 5 to 4,—that is to say, by using a copper conductor $\frac{1}{12\cdot4}$ of an inch diameter, in a gutta percha tube $\frac{5}{16}$th of an inch outer diameter.

From the letter in the *Daily News* (Oct. 9), I can form no idea of the rate which the experiments on the 2000 miles of cable promise for the delivery of the messages. That letter gives no information whatever which could not have been told ten years ago without experiment,† and which was not actually asserted by myself a year and a half ago,—except this, that the eminent men who directed and assisted in those experiments saw something that convinced them of the practicability of telegraphing, at a rate commercially advantageous, between Newfoundland and Ireland, by means of a cable of such dimensions and arrangement as that on which they made their experiments. If they can satisfy themselves that the effects of mutual induction between wires in a multiple cable of such a length will not be injurious, and that the rates of telegraphing which they can accomplish are as good as those I have indicated, then a multiple cable, such as that proposed by Mr. Whitehouse (*Athen.* Aug. 30, p. 1093), will be undoubtedly satisfactory. But the effects of mutual induction between three or four wires in a cable 2400 miles long will be decidedly more embarrassing in rapid operations than they have been found with shorter lengths; and even without the new plans of working to which I allude may be found so inconvenient that single wire cables will be preferred. If these new plans of wires are to be used, it may be necessary to have only one wire under one iron sheath, as I fear they would not succeed in a multiple cable, although on this point I cannot yet speak with confidence.

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* Or a single wire cable; copper wire $\frac{1}{15\cdot4}$ of an inch in diameter, in gutta percha tube $\frac{1}{4}$-inch external diameter.

† See my last letter to the *Athenæum*, published October 4.

I shall only say, in conclusion, that I intend to prepare and publish a table of different sets of dimensions for cables, with estimated rapidity of transmitting messages by each, which those engaged in projecting the Ocean Telegraph may find useful if their experiments leave anything undecided as to the best plan of cable for their purpose, if they have any confidence in scientific deductions from established principles.

INVERCLOY, Isle of Arran, Oct. 24.

On Nature Printing.[*] By HENRY BRADBURY, Esq., M. R. I.

(Continued from page 47.)

During the next twenty years Nature Printing was but indifferently prosecuted by various persons for various purposes. Mr. Taylor, of Nottingham, as far back as 1842; printed lace, &c., specimens of which were exhibited at the Great Exhibition; and Mr. Twining, of Nottingham, in 1847, printed ferns, grasses, and plants, which were exhibited by the Botanical Society of London. He adopted the same plans as those used by Kniphof and Hoppe.

In 1847, also, Dr. Furguson Branson commenced a series of experiments, an interesting paper upon which was read before the Society of Arts in 1851, and therein for the first time was suggested the application of that second and most important element in Nature Printing, which is now its essential feature—the application of the Electrotype.

"I beg leave," says he, "to bring before the notice of the Society of Arts a new method of engraving plates for printing ferns, leaves, sea-weeds, and other flat plants. . . . . Having taken in gutta percha some impressions of ferns, the singularly beautiful manner in which the exact character of the plant was transferred to the gum, suggested to me the possibility of printing from the gutta purcha itself, so as to produce on paper a *fac-simile* of the plant. That experiment partially succeeded, and curiously tested the elasticity of the substance; for the impression remained uninjured, after being subjected to the great pressure of a copper-plate roller. I say that it *partially* succeeded; for the printer found it utterly impossible so thoroughly to cleanse the ink from the margin around the impression, as not when printed to leave a dirty stain on the paper. The impressions thus produced were very accurate; but the process was valueless as regards multiplication of the prints."

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[*] From the Royal Institution of Great Britain.

It then occurred to Dr. Branson that an electrotype copy would obviate the difficulty.

He afterwards stated that he abandoned the process of electrotyping in consequence of his finding it tedious, troublesome, and costly, to produce large plates. Having occasion, however, to get an article cast in brass, he was astonished at the beautiful manner in which the form of the model was reproduced in the metal. He determined, therefore, to have a cast taken in brass from a gutta percha mould of ferns, and was much gratified to see the impression rendered almost as minutely as by the electrotype process;* but, however curious his individual specimens, the process produced no practical result.

In 1849, Professor Leydolt, of the Imperial Polytechnic Institute at Vienna, availed himself of the resources of the Imperial Printing-office to carry into execution a new method he had conceived of representing agates and other quartzoze minerals in a manner true to nature. Professor Leydolt had occupied himself for a considerable period in examining the origin and composition of these interesting objects in geology. In the course of his experiments and investigations he had occasion to expose them to the action of fluoric acid, when he found, in the case of an agate, that many of the concentric scales were totally unchanged, while others, to a great extent, decomposed by the acid, appeared as hollows between the unaltered scales. It occurred to Leydolt that the surfaces of bodies thus corroded might be printed from, and copies multiplied, with the greatest facility.

The simplest mode for obtaining printed copies is to take an impression direct from the stone itself. The surface after having been etched is well washed with dilute hydrochloric acid and dried; then carefully blackened with printer's ink. By placing a leaf of paper† upon it, and by pressing it down upon every portion of the etched or corroded surface with a burnisher, an impression is obtained, representing the crystallized rhomboidal quartz *black*, and the weaker parts that have been decomposed by the action of the acid *white*. It requires but a small quantity of ink—and particular care must be exercised in the rubbing down of the impression. This mode is good as far as it goes—but it is slow and uncertain—and incurring a certain amount of risk, owing to the brittle nature of the object; and the effect produced is not altogether correct, since it represents those portions black that should be white, and those white that should be black.

The stone is not sufficiently strong to be subjected to the action of a printing-press; an exact *fac-simile* cast, therefore, of it must be obtained, and in such a form as can be printed from. To effect this, the surface of any such stone (previously etched by corrosion) must be extended by imbedding it in any plastic composition that will yield a perfectly flat and smooth surface, so that the surrounding surface of the plastic composition will be exactly level with the surface of the etched stone: all that is necessary now is to prepare the electrotype apparatus, by which a perfect *fac-simile* is produced, representing the agate impressed, as it were, into a polished plate of copper. This forms the printing plate. The ink in this case, as opposed to the mode before referred to, is not applied upon the surface, but in the depressions caused by the action of the acid on the weaker parts; the paper is forced into these depressions in the operation of printing, which results in producing an impression in relief—a feature that is rather peculiar to the process, as the raised appearance, especially in the case of plants, adds very much to their effect.

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* The casting in brass is a very interesting experiment—but its results cannot be compared with the production of the electrotype.

† *India-paper* and *Chalk-paper* are the best adapted for the purpose.

The impressions printed in this latter manner present far more beautiful and natural representations, since the crystallized quartz are represented *white*, while the decomposed parts appear *black*.

Professor Leydolt, however, suggests that some corroded stones are better suited sometimes for one method of representation than the other; and attention should be paid to this while the stones are being exposed to the action of the acid. He considers that important advantages will result to science from the perfect faithfulness of such representations, and from the facility and inconsiderable expense of their production.

Other objects in geology—such as the fossil remains of fishes, plants, and other organic remains—in some cases can be, and have been, copied with unmistakeable resemblance to the original.

It is not clear who may have suggested the possibility of creating impressions of these last-named objects, but one thing is beyond a doubt, that the production of them was left entirely to the judgment of Andrew Worring, as was also the case in the production of the agates and other stones.

In operating upon this class of objects, it is desirable that the original should be as flat as possible, as the flatter the general surface is, the more successful will be the effect produced.

A mould in the first place is taken with gelatine or liquid gutta percha, the elasticity of which materials are favorable for flattening the mould without distortion when separated from the original,—a mode that is to be preferred to depositing copper direct upon them, since it is very much more easily manipulated, and without the slightest risk of damaging the originals, owing to the absence of pressure.

This gelatine or gutta percha mould is rendered metallic or conducting in the usual way by the application of plumbago, and copper is deposited until of sufficient thickness to form a printing plate.

In 1852, Mr. Aitken, of Birmingham, followed the footsteps of Kyhl in various experiments made by him in Britannia metal. He took impressions of lace, skeleton-leaves, feathers, &c., in Britannia metal, for the purpose of ornamentation, in the same way as Kyhl is said to have done in articles of silver. About this period Dr. Branson again made experiments, and endeavored to bring Nature Printing into practical operation. He too tried impressions on Britannia metal, not altogether with the view of printing direct from such plates, desirable as it would be to dispense with the operation of taking casts—but of transferring impressions to stone; and after printing an impression in some neutral tint, to resort to coloring by hand. (Specimens of this method were lying on the table; but, on examination, would not bear comparison with the productions of the present time.)

In the Imperial Printing-office of Vienna, the first application of taking impressions of lace on plates of metal, by means of rollers, took place in the month of May, 1852:* it originated in the Minister of the Interior, Baumgartner, having received specimens from London, which so much attracted the attention of the chief Director, that he determined to produce others like them. This led to their using gutta percha in the same way that Dr. Branson had used it; but finding this material did not possess altogether the necessary properties, the experience of Andrew Worring induced him to substitute lead, which was attended with remarkable success. Professor Haidinger, on seeing specimens of these laces, and learning the means by which they had been obtained, proposed the application of the process to plants. The results of these experiments,† as well as those of Professor Leydolt above referred to, appeared in the fifth volume of Memoirs of the Imperial Academy, published at Vienna, in 1850.

Up to this time, however, in England, notwithstanding the abovementioned experiments, the discovery had not assumed any practical form; but there is little doubt that if any of these persons had had the requisite means and appliances it would have been brought to perfection earlier. These consist mainly in the precipitation of metals upon moulds or matrixes by means of electro-galvanic agency.

Nature Printing owes it present success to the electrotype, which was then, and even at the present time is, the only means by which *faithful* copies can be taken of those delicate fibrous details that are furnished in the examples of the impressions of botanical and other figures in metal. It may be said to be owing to the extensive scale upon which the process of the electrotype is conducted in the Imperial establishment, that Worring was enabled to render the process of Nature Printing practically available as a Printing Art.

The deposition of metals by galvanic agency, though long known and practised in England, has been considered more as a *scientific* than a *practical* mode of casting; and it is only within the last few years that its value in its manufacturing capabilities has been properly understood. Up to within a short time it has been found uncertain, difficult, tedious, expensive, and requiring great length of time to obtain adequate results from it; but Mr. Bradbury stated, that he had for the last two years devoted his energies to overcome these difficulties, and that his experiments had been attended with many practical advantages in the Art of Printing. On the table before him he had a small electrotype apparatus, by which was produced a perfect electrotype cast of an impressed metal plate before the audience in half an hour.‡ He stated, that one of his experiments had been crowned with such success, that he had reduced the operation of the battery and the decomposition trough to so rapid and certain a result as to be able to duplicate the woodcuts contained in a number of the *Illustrated London News*, no matter what their number or size, in the short space of twelve hours (ready in every respect for the press), which he stated as his belief, was one of the greatest practical accomplishments that had ever been made in any country in this branch of science; the value of which to the journal in question will be best understood when it is known, that without *this* or other means (not yet discovered), the production of the requisite number of copies in time for publication, would be a mechanical impossibility, (so extensive is its circulation,) since from *one* set of engravings there is a limit to the number of impressions that can be printed from *one* machine in a given time.

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* The Austrian patent was taken out on the 12th October, 1853, in the name of Andrew Worring.

† These consisted of specimens of lace, leaves, plants, mosses, serpent skins, the wing of a bat, agates, fossils, and petrifactions; and it is somewhat curious that these examples were similar in character to those chosen by Kyhl.

‡ In the afterpart of the evening Mr. Bradbury succeeded in producing thin electroplates of impressed plates in five minutes.

The mode of printing these electrotype* plates of plants is the same as in the ordinary copper-plate printing, where the impression is produced by passing the inked plate with the sheet of paper laid upon it through a pair of rollers, one of which is covered with four or five thicknesses of blanketing, which causes the peculiar raised or embossed appearance of the impression.

In such cases, where there are three, four, or more colors, for instance, —as in flowering plants, having stems, roots, leaves, and flowers,—the plan adopted in the inking of the plate is to apply the darkest color first, which generally happens to be the roots—the superfluous color is cleaned off,—the next darkest color, such as perhaps the color of the stems, is then applied—the superfluous color of which is also cleared off,—this mode is continued until every part of the plant in the copper-plate has received its right color. In this state, before the plate is printed, the colors in the different parts of the copper, look as if the plant was imbedded in copper. By putting the darkest color in at the beginning, there is less chance of smearing the lighter ones: the printer too is not only able by this means to blend one color into another, but to print all the colors at one single impression.

The *first* practical application of Nature Printing for illustrating a botanical work, and which has been attended with considerable success, is Chevalier Von Heufler's work on the Mosses,† collected from the Valley of Arpasch, in Transylvania; the *second*, (the *first in this country*,) is the "Ferns of Great Britain and Ireland," in course of publication, under the editorship of Dr. Lindley, and printed by Messrs. Bradbury & Evans. Ferns, by their peculiar structure and general flatness, are especially adapted to develop the capabilities of the process, and there is no race of plants where minute accuracy in delineation is of more vital importance, than the Ferns; in the distinction of which, the form of indentations, general outline, the exact manner in which repeated subdivision is effected, and most especially the distribution of veins, scarcely visible to the naked eye, play the most important part. To express such facts with the necessary accuracy, the art of a Talbot or a Daguerre would have been insufficient until Nature Printing was brought to its present state of perfection.

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* The copper deposited upon moulds by electro-galvanic agency, is precipitated in such inconceivably small atoms, that the defects previously referred to in the surface of the lead plate, are also *faithfully* copied, but the surface of copper (unlike that of lead) will allow of these defects being removed by the aid of the burnisher, and a polished surface preserved.

† *Specimen Floræ Cryptogamæ vallis Arpasch Carpatæ Transylvani;* Conscripsit Ludovicus Eques de Heufler. Vienna, 1853. Imp. folio.

Mr. Bradbury then adverted to the ingenious and beautiful productions of Felix Abate, of Naples. His Nature representations consist of sections of wood, in which the grain is admirably represented. He terms his peculiar process Thermography, or the Art of Printing by Heat. The process consists in wetting slightly the surface of the wood, of which *facsimiles* are to be made, with any diluted acid or alkali, and then taking an impression upon paper, or calico, or white wood; the impression is quite invisible, but by exposing it for a few instants to a strong heat, the impression appears in a more or less deep tone, according to the strength of the acid or alkali. In this way every gradation of brown from maple to walnut, is produced; but for some woods which have a peculiar color, the paper, &c., is to be colored, either before or after the impression, according to the lightest shades of the wood. Abate, in his manipulations, also employs the ordinary dyeing process.

It is to be hoped that Abate's process may become alike useful to the natural sciences and the decorative arts.

Mr. Bradbury stated in conclusion, that we are indebted to—

Kniphof, for the application of the process in its rude state;
Kyhl, for having first made use of steel rollers;
Branson, for the suggestion of the electrotype;
Leydolt, for the remarkable results he obtained in the representation of flat objects of mineralogy, such as agates, fossils, and petrifactions;
Haidinger, for having promptly suggested the impression of a plant into a plate of metal at the very time the *modus operandi* had been provided;
Abate, for its application to the representation of different sorts of ornamental woods on woven fabrics, paper, and plain wood;
Worring, of the Imperial Printing-office, Vienna,* for his practical services, in carrying out the plans of Leydolt and Haidinger.

Nature Printing may be considered as still in its infancy; but the results, already obtained in its application, encourage us to expect from continued efforts, such further improvements as will place it not least among the Printing Arts. [H. B.]

The New American Steamships of War.†

The visit of the large American steam frigate *Merrimac* to Southampton having occasioned considerable interest, we think it may now be a proper time to lay before our readers such information as we have from time to time obtained respecting her, and the *Wabash*, the *Minnesota*, the *Roanoke*, and the *Colorado*—four ships of much the same size and power as the *Merrimac*—and also respecting the huge steam corvette the *Niagara.* In order to render the information which follows perfectly reliable—in so far at least, as the *Merrimac* is concerned—we have visited that vessel, and verified by personal observation the facts hereafter stated. In making this verification we were favored with the utmost courtesy and co-operation on the part of the officers of the ship, and particularly of First Lieutenant G. W. Harrison, who was in command of her at the time of our visit, and to whose kindness we are much indebted.

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* It is gratifying to know that the services of this gentleman, were recognised by his Sovereign, who munificently rewarded him with a gift, and likewise the Order of Merit.

† From the Lond. Mech. Mag., October, 1856.

The principal dimensions of the five frigates above enumerated are so nearly alike that they may, for all ordinary purposes, be considered the same, and may be taken as follows:—*

Length on keel,	250	feet.		
" " load water line,	260	"		
" over all,	300	"		
Breadth extreme,	51	"	4	inches.
" moulded,	50	"	2	"
Depth of hold (to gun deck),	26	"	4	"
Draft of water forward,	23	"	6	"
" " aft,	24	"		

As our examination of the *Merrimac* was made for the purpose of estimating her merits as a ship of war, we must add to the above the following details, which are of importance in such a ship. When the vessel is at her load line, the heights of the gun deck ports above the water are amidships 9 feet, and forward and aft 12 feet, or thereabouts. The height from her gun deck to the lower sides of her spar deck beams is 6 feet. The height of her bulwarks is such that, when the hammocks are stowed, they reach 8 feet 8 inches above the upper deck. Her gun deck ports are 3 feet 8 inches long, and nearly 8 feet 6 inches apart. Her load displacement is estimated at 4000 tons; but this we could not, of course, test.

The *Merrimac* was designed by Mr. Lenthall, who is at the head of the Bureau at Washington,† and was built by Mr. Delano, the master shipwright of the Navy Yard at Boston (or the officer who corresponds to a master shipwright of our own dockyards). Her frame is of live oak, crossed on the inside with two sets of diagonal iron plates which are inclined in opposite directions. She is also strengthened by similar plates on the outside at bow and stern. Her plank is also of oak, and, like our own ships of war, she is copper-fastened up to a few feet above the load water line. Her decks are of fir. On a careful inspection, she seems to have been built with very great skill and care, and is a very tight, strong ship. The large wooden knees (common in American ships because more approved of, and more readily obtained than iron,) to some extent interfere with the beauty of her appearance inboard. But she is a very roomy and handsome ship, and the appearance of her main deck is unsurpassed.

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* Almost the only difference between the dimensions of these five frigates is a slight one in their lengths. But this is a difference of about five feet or six feet only at most. The *Wabash* is said to be 5 feet 8 inches longer than the *Merrimac*; but even this is true only when the length is measured at the load line.

It may be well to state here that we are in possession of numerous statistics relating to these ships, which we have not thought it necessary to give, because they can only be of use to the constructors of ships of war, who do not trust to scientific journals for the elements of foreign vesssls. We see no utility in publishing, in isolated cases, such quantities as the height of the metacentre, and the moment of stability, for instance. We consider that their publication, under such circumstances, is always pedantic, and are confident that they are frequently given in absurd forms. Only recently we saw in a contemporary, among the statistics of the *Niagara*, these words:—"Movements of stability ($S\frac{2}{3}\, y^3\, ax$), 2,415,560 sq. ft." This was probably intended to be, "Moment of Stability ($\frac{2}{3} f y^3\, dx$), 2,415,560." But even this is, of course, wrong; every naval architect knows that the quantity $\frac{2}{3} f y^3\, dx$ is not the moment of stability, but the moment of inertia of the load water section.

† The four sister ships were also designed by Mr. Lenthall. The American *Nautical Magazine* says, "In the appropriation for these six auxiliary steamers there was one prominent exception. Congress determined that one of these ships should be constructed by a private builder, and Mr. George Steers, the constructor of the yacht *America*, was entrusted with her construction; while the other five were left in the hands of the Bureau of Construction, perhaps that their models might indicate their origin."

With all her sails set, she spreads 56,629 square feet of canvass. Her engines are auxiliary only. Her rig is in all respects like that of the largest American sailing frigates, but from her great length she seems capable of carrying masts, spars, and sails even larger than those she has. The mode in which the mainmast steps is worthy of attention. The shaft of the propeller coming immediately beneath it (since the engines are before the mainmast), a step is formed to receive it above the shaft. This step consists of a large thwartship beam of live oak, supported near the middle by two 12-inch solid iron columns which rest upon suitable keelsons. This arrangement is perhaps as good as any other, although the strength attending it must certainly be much less than that in which the mast steps in a wooden step supported immediately by the keelsons themselves, as is the case where no screw shaft interferes. The modes adopted in our own navy are various. In some cases tall iron forked steps, which stride across the shaft, are employed, and in others the heel of the mast itself is enlarged, and the shaft allowed to pass through it, the lower piece of the mast being separable from the upper, and connected with it by clasp-jointed hoops.

The *Merrimac* is pierced for 60 guns, but if she were actually to carry that number, they would have to be of a lighter character than those now on board of her. Her present armament is as follows:—On her upper deck there are two large pivot guns, each weighing nearly 5½ tons and of 10 inches bore, and fourteen 8-inch guns, each weighing rather more than 3 tons; on her gun deck there are twenty-four 9-inch guns, each weighing nearly 4½ tons. The whole of these guns, forty in all, though strong enough to discharge solid shot, if desired, are primarily intended to be served with hollow shot, or with shell,—for it is now a practice with the Americans to supply their navy with a quantity of empty hollow shot, which may be either plugged and used as such, or charged, fitted with fuzes, and used as shells. We must not, however, omit to mention that she might carry a few additional 9-inch guns on the main deck with perfect convenience. Her gun carriages on the main deck are similar to those used in the French navy. They have, however, but two wheels or trucks each, at the ship's side end of the carriage. To facilitate the running out of the gun, the rear end of the carriage is raised by a handspike fitted with a roller at the end, on which roller the carriage runs out. At the upper side of this handspike roller is a pin or stud, which takes into one or other of a series of recesses formed in a plate on the underside of the rear end of the carriage. The carriage slides of the large pivot guns differ from our own chiefly in the fact that they are furnished at each end with wheels or trucks (which run on the metal circular bearing plates on the deck) mounted on eccentric axles. These axles are turned by a spanner, so as either to take the weight of the slide and allow it to be run round upon them, or to be raised clear of the bottom of the slide, and allow it to rest immediately upon the deck plates. The carriages which run upon the slides have their rear trucks mounted upon similar eccentric axles. The friction of the carriage upon the slide when the piece is to be discharged (and when the trucks are clear of the slide,) is sometimes increased by nipping the two together with screws.

The whole of the 9-inch guns, or main-deck guns, as well as the two 10-inch pivot guns, are formed upon Commander Dahlgren's system, which consists in giving to the gun, at each point of its length, a thickness proportioned to the direct pressure of the powder in the chase at that point, supposing the gun to be fired with an ordinary service charge. In order to carry out that principle, Commander (at the time Lieutenant) Dahlgren took an ordinary paixhan gun, and had bored in it a number of holes, each of the size of a musket ball, extending from the outside of the gun through into the chase. These holes were perpendicular to the axis of the gun. A musket ball was then placed in the first hole (the remainder of the holes being plugged for the time), the gun fired with a service charge, and the initial velocity communicated to the musket ball measured by a ballistic pendulum. This was repeated with each hole successively, and lines representing the initial velocities thus obtained were taken as the ordinates of a curve (of which the distances apart of the holes represented the abscissæ), and this curve gave the contour of the exterior of the gun. The Dahlgren guns are of greatly reduced thickness along the chase, and suddenly increase their thickness near the breech, where the great bulk of the metal of the gun is collected. Before the adoption of them in their navy, the American government had them severely tested, with highly satisfactory results. Without doubt, the principle of Commander Dahlgren is correct, so far as it goes. There are also collateral advantages connected with the adoption of it in naval ordnance, one of which is that the centre of gravity of each side battery is, owing to the form of the guns, thereby brought nearer to the middle of the ship, which must tend to make her roll less heavily than otherwise. Each gun is furnished with two lock-lugs, or lugs for the gun-lock—one for use, and one to supply its place if it should be knocked away.

There are a few other novel features in connexion with the guns of the *Merrimac.* One is that her guns are fitted with elevating screws, which supply the place of the *coin*, &c., in our own service. This arrangement tends greatly to facilitate the sighting, and is certainly an improvement, provided that it is not attended with any defect in strength, and we were assured that none had been observed during considerable practice. Another new feature is the employment of bristles, instead of sheepskin, in all the sponges and rammers for the guns; and a further one is the employment, for boat guns, of light and elegant wrought iron carriages, of which she has three, one for a 9-pounder, a second for a 12-pounder, and a third for a 24-pounder.

The engines of the *Merrimac* are by Mr. Parrott, of the Cold Springs Foundry, New York. She has two cylinders 72 inches in diameter, and 3 feet stroke. These are placed close to the shaft, on opposite sides of it, leaving room only for the crank. Each piston has two piston-rods, one above and one below the shaft; these carry a cross-head, from which the connecting rod reaches back to the crank, as is well understood by engineers. Each cylinder has its condenser at the side of it, and its air-pump opposite to it. The air-pump rods go through the cylinder ends direct to the piston. She is fitted with four of the vertical tubular boilers patented by Mr. D. B. Martin, Engineer-in-chief of the U. S. Navy, similar to those fitted previously in the *Susquehanna*, by Merrick & Son, of Philadelphia. The boilers are of iron, with brass tubes, and have the following general dimensions:

Length of each boiler, athwartships, 11 feet; breadth, fore and aft, 14·8 feet; length of vessel occupied by four boilers, 31 feet 8 inches; breadth of ditto, and fire-room, 31 feet. The fire-room is between the two pair of boilers, the furnaces firing athwarships, and the flues delivering into one chimney. Height of boilers, 13 feet 6 inches; cubical space occupied by all the boilers and fire-room, being the content of a parallelopipedon included within the above circumscribing lines, 13,240 cubic feet; number of furnaces in all boilers, sixteen; breadth of ditto, each, 2 feet 10½ inches; length of ditto, each, 7 feet; grate surface area in all, 338 square feet; number of tubes in all boilers, 5480; length (or height), 37¾ inches; diameter (outside) of the tubes, 2 inches; heating surface in furnaces and back connexions up to tubes, 1614 square feet; heating surface in tubes, 8508 square feet; heating surface in tube-boxes and connexions to smoke chimney, 1581 square feet; total heating surface in all boilers, 11,703 square feet; proportion of the same to grate area, 34·6 to 1·00; flue area or calorimeter between tubes in all boilers, 42 square feet; proportion of the same to grate area, 1 to 8 square feet; diameter of smoke chimney, 8 feet.

The boilers all have water-bottoms, with not less than 6 inches of water-space at any point; back of the furnaces these bottoms rise to the back connexions; the tube-boxes are above the furnaces, and rise about 3 inches to the front end of the boiler, where they enter the front connexions. The boilers are of ⅜th inch and ½ inch best American plates, double riveted and caulked inside and out, throughout, and are well braced. The weight of all four, when empty, is 255,000 lbs. Their total weight, when filled to the working level, is 440,000 lbs.

To test the economical evaporative efficiency of this form of boiler, an experiment was made on the 13th of March last, in the presence of several engineers of the navy, the conditions and results of which were, as published by Mr. Merrick, the maker, as follow:

Two boilers only were used, and the dampers were nearly closed.

The coal used was anthracite, and of an inferior quality. The engines are fitted with Stevens' cut-off, which was adjusted and permanently fixed to cut off as follows:

Port engine, one end, . . .	3·88
" "	4·12
Starboard engine, one end, . . .	4·60
" " . . .	3·35
Average per indicator card, with full throttle, .	3·97 feet.
Adding to this the average clearance at each end of the cylinder, and including, also, the steam passage, &c., between valves and cylinder, equal to 23·820 cubic inches, or the area of the cylinder by 6·05 inches* of stroke, or . .	·504 "
Average length of cylinder, filled at each single stroke,	4·474 "

Preserving the same level of water in the boilers, and (as nearly as could be ascertained) the same quantity of coal in the furnace, or about the same fires, and maintaining the same pressure of steam, 4200 lbs. of coal were consumed, and 1615 revolutions made and noted by register, the duration of the experiment being 3 hours 57 minutes. During this time eleven double cards were taken on the two engines, which showed a mean pressure of steam entering the cylinders, during that part of the stroke over which steam was admitted of—

Total pressure—Port engine, 18·99 lbs.; starboard engine, 21·81 lbs., of which (Pambour) the volume is 1257.

Hence, the water evaporated during the experiment was as follows: the two cylinders being 70 inches diameter=26·41 square feet of area.

$$26{\cdot}71\times4{\cdot}74\times1615\times4\times62{\cdot}5$$

$$1257=39{,}372.\ \text{lbs of water.}$$

which, being evaporated by 4200 lbs. of coal, gave 9137 lbs. of water per lb. of fuel.

The temperature of the hot-well was 89½°, and of the feed-water entering the boiler at (probably) 85°. The evaporative power of the boilers will at once be seen from the above figures of Mr. Merrick. In the *Merrimac* very excellent results have also been obtained with Mr. Martin's boilers. Her coal bunkers carry about 600 tons of coal. A small pair of donkey engines are provided on the main deck for coaling, raising heavy weights on board, &c. These auxiliary engines have a suitable boiler to supply them when the main boilers are not at work. Two steam pumps are fitted in connexion with the large engines for pumping out the bilge, extinguishing fires, &c. These steam pumps may be supplied with steam from the auxiliary boiler, if desired. The *Merrimac* is fitted with a Griffith's screw propeller, with means of varying the pitch. In this respect she differs from her sister ships, all of which have ordinary propellers. The *Niagara* is, we understand, to have a Griffith's.

The propelling arrangements on board the *Merrimac* are very complete. The forward thrust is taken by a series of collars, and the backward thrust by a brass disk dropped down between the end of the propeller bearing and the after stern post. This disk may be readily renewed when worn. The shaft is supported between the engines and the dead wood by bearings and intermediate spring supports, and a cooling pipe is led from the outside of the ship over each. The after propeller bearings are of wood, upon Penn's principle. The propeller is raised by a cable and pulleys, the cable leading to the capstan. A long wooden stay, tightened by a screw, is used for keeping the propeller down in its place, and suitable means are also provided for steadying the propeller during the raising of it, for slinging it when raised, or partially raised, &c.

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* This enormous amount is taken from actual measurement, and is stated to be, in a great measure, incident to the form of engines (inclined) with which the ship is supplied.

The greatest speed ever attained by the *Merrimac* under steam alone was seven knots per hour, and this was made under very favorable circumstances. Her average steaming speed is much less than this. There are, however, certain defects in connexion with her slide-valves which prevent the full and economical results being attained with her engines. The lap and lead was so small, that at first she could not cut-off her steam until 19 inches of her stroke: she will, for the future, owing to improvements made on board, cut-off at 15 ins. But radical changes must be made in her valves before the necessary economy is obtained. The details of the engines—the driving gear, &c.,—are very well arranged.

The *Merrimac* is full of evidences that the American government are willing to give trial to improvements of a promising character in their ships of war, notwithstanding the changes which their introduction renders necessary. At the same time there are arrangements, which have been proved highly valuable in our own service, unadopted by them. For example, instead of the admirable lightning conductors of Sir W. Snow Harris, used with so much advantage by us, the old bit of chain long discarded here, lies down against her shrouds, and gives great offence to the eye of the intelligent visitor. But, on the whole, the useful improvements greatly out-number the defects. This we might show at great length if we thought it desirable. It will, however, be sufficient to add a further fact or two. The fish-davit is centered on a hoop on the foremast, and may be swung over either anchor for fishing it, and may also be used to assist in the removal of the heavy berthing which has to be taken down when the bow pivot gun is used. Both operations may be performed by steam power derived from the auxiliary engines. Another useful arrangement is the use of a hinged tongue-piece, which may be pressed down between the links of the cable by a screw when the cable has to be fleeted. Another is the employment of light bulkheads around the engine-room hatches on the main deck. Whether the absence of all mess tables for the ship's crew is an improvement or an act of retrogression, we leave naval officers to decide.

In our next number we shall probably publish a few further statements respecting the *Merrimac.* At the same time, we believe that the points of chief importance are included in the above remarks.

The *Niagara* is built, we are told, as an experiment; and it is perfectly certain that if she should prove a thoroughly strong and efficient ship of war, she will surprise every one who has hitherto been considered well informed on the nature and requirements of war ships. The history of this ship's origin is simply this:—Mr. Steers, of New York, built the *America* yacht, which proved to be a very fast one. This gained him reputation and friends, and secured him orders for constructing various other vessels of larger sizes. He succeeded in building more than one fast and serviceable commercial steamship, and when the American government resolved upon making a demonstration with large steamships of war, Mr. Steers, or the friends of Mr. Steers, succeeded in getting the design and construction of one committed to him. Mr. Steers knew but little, if anything, practically of ships of war; and, if we are rightly informed, cared to know but little of them, except what the light of nature supplied him with, for, we are told, he availed himself but very little of the freedom with which he was permitted to have access to the Bureau of Construction and all that it contained. More than one professional American gentleman has spoken to us strongly upon this point. "It was but reasonable," says the United States *Nautical Magazine*, "to suppose that every facility would be afforded Mr. Steers, now that improvement seemed to be really intended, and, with the exception of the propelling power in the quantity of canvass, the ground tackle in the kind of anchors, and the ventilation in the improved side-lights he has thought proper to use, he has been allowed to exercise his own judgment, both in the model and manner of construction, and is, like the constructor of the *Ohio*, quite willing to take the whole measure of responsibility, having a full knowledge of its weight and bulk. This vessel, as her dimensions and calculations will show, is the largest of the six, and is also of a very different model and construction. In the construction of the *Niagara* it is alleged that there are principles involved which are of great importance to the safety of vessels, which have never been appreciated in the navy, either in this country or elsewhere. It was supposed that in the model and internal arrangements alone would this vessel differ from the other five vessels; but it is discoverable that not only is the form of the fabric and her arrangements in armanent different, but that the manner of distributing the materials throughout the vessel is also entirely different, utility being regarded as of more consequence than the time-honored precedents, the constructor having sought to secure the greatest amount of strength with the least bulk."

The principal dimensions of the *Niagara* are as follows:—

	ft.	ins.
Length on load-water line, . .	328	10
" over all, . .	345	0
Breadth extreme, . . .	55	0
" moulded, . .	53	8
Depth of hold to spar deck, . .	51	3
Draft of water, . .	26	0

Her ports are fifteen feet above the load-water line. Her height between decks is 7 feet 3 inches to the under side of beams! Her displacement at 23 feet draft is 5440 tons. Her frame is of live oak, filled in below with yellow pine, and crossed on the *outside* with two sets of diagonal iron plates inclined in opposite directions. She is also strengthened forward by similar diagonal plates laid across the beams of the upper deck. Her plank of bottom and decks are of yellow pine. Having a very fine run, she is, of course, weak at her quarters, in consequence of which, Mr. Steers has fitted on each side a large 2-inch iron stay or brace, which lies along the upper deck beams, and passing through the decks below steps upon the stern post. This is certainly a curious arrangement for a ship of war. It may as well be added here, that when she is docked, it is thought necessary by Mr. Steers to brace her two sides together, at about the turn of the bilge, by means of a chain, which passes over a frame or saddle, which is set up by wedges to tighten the chain.* She is rigged like the *Merrimac* and others.

The *Niagara* carries 12 guns, 5 of a side, and 2 pivot guns, each of them 11 inches in the bore, and weighing upwards of 7 tons. All the guns are mounted on pivoted carriages, and the broadside ports have consequently to be very large—9 feet long and 4 feet high. Through ports of this size the guns would be easily dismounted in close action; but the *Niagara* is intended to be fast, and, being furnished with long range guns, is supposed to have the power of annoying and injuring an enemy, while she herself keeps out of the range of her enemy's guns. She was, in fact, designed for the express purpose of giving the Americans the advantage over all existing ships; it is satisfactory, however, for us to know that in our dock-yards there are already several new class ships quite competent to match her, and, if we are not mistaken, to give a good account of Mr. Steer's experiment. We should be pleased to know with certainty that such a trial of strength is not likely to come off; we hope it never may.

The engines of the *Niagara*—designed by Mr. Copeland, and built by Pease & Murphy, New York—are similar to those of the *Merrimac*, but she has three cylinders, each 72 ins. diameter and 3 feet stroke, instead of two. Each frame for cylinders is cast in one piece; the cylinders have slide valves, and a separate cut-off or expansion slide valve adjustable so as to cut off at any point from three-eighths to five-eighths of the stroke. Each cylinder has its own separate condenser, air pump, and hot-well; in fact, there are three complete engines, so that, should either become deranged, the others would be still available. The screw propeller (formed of composition) is 18 feet 3 inches diameter and 4 feet 2 inches long, with pitch of 29½ feet (at the periphery). The boilers are four in number, 11½ feet long, 21 feet wide, and 15 feet high. Like those of the frigate, they are Mr. Martin's vertical tubular. They are set in pairs, the flues discharging into two chimneys.

In concluding these remarks we would refer our readers back to page 125 of our number for Aug. 9, (No. 1722), in which we published a very excellent (though not faultless) criticism upon the *Niagara*, extracted from the *Journal of the Franklin Institute*.

Bessemer's Improvements in making Malleable Iron, &c.†

In our September number we gave a report *in extenso* of the very interesting paper read by Mr. Bessemer, before Section G., at the Cheltenham meeting of the British Association, in which this important invention was, for the first time, announced to the public. We were also exclusively enabled to give an accurate report of the more interesting parts of the discussion, which followed the reading of the paper. We were also the first to give an illustrated description of the converting vessel and apparatus, as used by Mr. Bessemer; and to describe the experiments made at Baxter House, for the purpose of demonstrating the practicability of the process.

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* Notwithstanding these signs of anticipated weakness in the *Niagara*, it has been stated by a person who sighted her both in the stocks and subsequent to her launch, that she "broke" only one inch in her length. This is so extremely improbable that we almost think he must have sighted her *athwartships* instead of *fore and aft!*

† From the Lond. Artizan, Nov., 1856.

During the time intervening between the first public experiment, on the 22d of August, and the end of October, we have very frequently witnessed experiments variously made, for the purpose of testing the invention in every conceivable manner; and with but two or three exceptions (and these resulted from inadvertence or inattention), every demonstration was successful; and, notwithstanding all that those who are either adversely interested, or ignorant of the matter, may say, *the invention is in principle correct*, and all that Mr. Bessemer professed, he was able to do—in the way of converting, by one operation, the crude pig iron, into refined metal, fit for rolling and working into malleable iron—this he *is* able to do, and does unmistakably.

That greater experience is required in the management of the operation, is undeniable; but the very failures which have arisen from the deficiency in this respect, have proved the correctness of Mr. Bessemer's principle.

We have seen some of the *burnt iron* produced by accident, during an experiment, converted into *fine fibrous iron* rods and sheets, by re-heatings and workings.

The following is an account of experiments made under the superintendence of Messrs. Smith, Phillips & Co., the owners of the Dafen Tin Plate Works, Llanelly:—

In the first place, the firm furnished Mr. Bessemer with a mixture of different sorts of pig iron, such as are used by them for making their best charcoal bars. This was melted in the presence of one of the firm at Baxter House, and then run into the converting vessel, and in twenty-five minutes an ingot of soft malleable iron, 10 inches square, was produced. It was so soft, as when cut with a chisel, to have almost the appearance of lead. The charge of iron being insufficient to fill the mould, a thin crust was formed at the upper end of it, and so strong was it that it required considerable exertion with a heavy sledge hammer, before a small piece, about an eighth to a quarter of an inch thick, could be broken off. The 10-inch ingot being too large to be treated properly there, Mr. Bessemer had it hammered down at Woolwich into two ingots of about 4 and 5 inches square. It was evidently injured by this process, having been apparently overheated, for the two ingots broke easier than ordinary pig iron of the same size would do. This was very discouraging, but the firm determined to continue the trial. They began by heating part of an ingot in a hollow fire, and when it was at a white heat, it was reduced under a 30 hundred weight steam hammer to a slab, about 5 inches wide by 3 inches thick. This was again heated and rolled into a bar, half an inch thick, and a very wretched looking bar it is stated to have been, being deeply cracked all down one side. Much better bars have, however, since been made from part of the *same* ingot. So bad was it, that one of the firm thought it useless to proceed further with the experiment; but another member, nothing daunted, had it cut up into pieces of the usual length, and taken to the mill. It proved to be what is called in the trade, very cold short, and did not cut at all well. Here, however, the difficulties ended, for it rolled beautifully into sheets, to the amazement of all who were present. The thinnest of the specimens sent (all of which were made from the unpromising looking bar above mentioned) is what is called "tagger" iron, and is unusually thin. At all events, none so thin have ever before been produced there, or at all approaching to it. It will be found, on bending it, that it is remarkably tough. The thicker piece of iron of the specimens sent, has not been annealed, and therefore is not so tough; but the same iron, annealed and finished as tin plate, stands what is considered a very severe test, namely, twice doubling without cracking. The firm have reason to believe it is fully equal to plates of the same substance made from their best charcoal iron.

This experiment, and others since made, lead to the belief that, if uniform results can be obtained from the converting vessel, and if the same quality pig iron is always used, there is every reason to believe that the invention will prove very valuable to tin plate makers, as there is clear proof that sheet iron of superior quality may be produced by adopting it.

The best way of working the large ingots into bars has yet to be learnt; but it is expected that the plan Mr. Bessemer recommends, of passing them through a series of rolls, will be found to answer perfectly. It may be mentioned that Messrs. Smith, Phillips & Co., tried a piece of the bar from which the specimens sent were rolled, in the blacksmith's shop. It proved to be very red, short, and difficult to work; so that some further improvement in the process is required before iron made by it can be brought into general use.

One of the disadvantages under which Mr. Bessemer labored in connexion with his experiment made at Baxter House was, that during the pouring of the molten metal from the converting vessel, after being refined, the air was carried into the mould with the metal, and produced very porous ingots.

To remedy this defect, which was of the greatest disadvantage in connexion with the steel or semi-steel produced by this process, Mr. Bessemer proposed a plan of pouring the metal, by means of a novel contrivance, in which the same principles were involved as in his converting vessel, except that the cold air is driven *on to* the surface of, instead of *into* the midst of, the fluid metal.

Mr. Bessemer, in specifying the patent for his invention, gives the following description of the very ingenious contrivance which he has superadded to his former apparatus, and of which we now give illustrations, kindly furnished to us by Mr. Bessemer. He says:—

In carrying this invention into practical operation, it is preferred to mount the refining vessel or chamber on axes not situated at or near the centre of gravity of the chamber, by which means the pouring out of its contents will be facilitated, and the spout kept in a proper position in reference to the mould during the time of pouring the fluid metal therein. The air may be introduced at the sides or ends of the vessel, through small holes formed in pieces of well-burnt fire-clay, so that by moving the chamber or vessel on its axis, the holes in the fire-clay may be made to descend beneath the surface of the metal, or be raised above it, as desired. It must be observed that the air or other gaseous matters, must be compressed with a force greater than will balance the weight of a column of fluid metal of a height equal to the depth of immersion of the jets below the surface of the fluid metal.

The accompanying illustrations show the form of apparatus employed: Fig. 1 being an end elevation; Fig. 2 a cross section; and Fig. 3 a longitudinal section of the vessel or chamber. Fig. 2 shows the vessel half turned up, but in Figs. 1 and 3 it is shown in its lowest position. The tuyere pipes are also shown in detail at Figs. 4, 5, 6, 7, 8, and 9.

FIG. I.

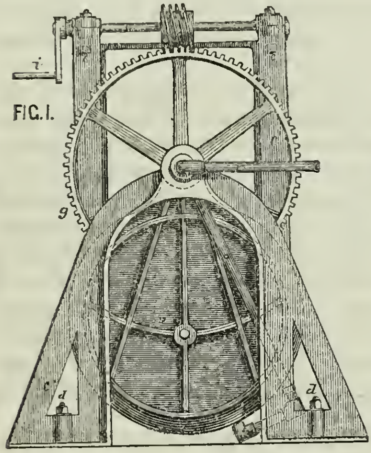
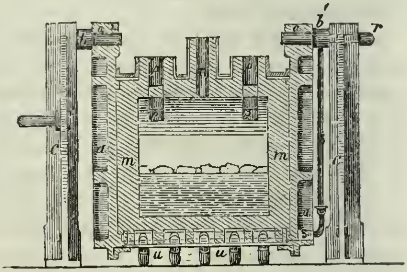


FIG 3



The cylindrical vessel *a* is formed of stout plate iron, secured by angle iron flanches, to the cast iron plates a^1, on which ribs or webs are formed, for the purpose of giving to them the requisite degree of strength. At

FIG 2.

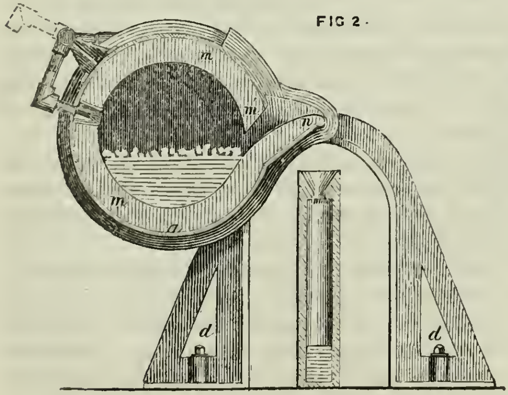


FIG 4

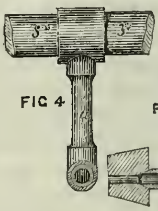


FIG 5

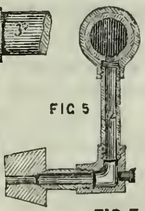


FIG 6

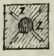


FIG 7

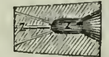


FIG 8

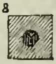
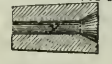


FIG 9



one side of the plates a^1, and at a point beyond their outer edges, bosses are formed: they are bored out truly and fitted and keyed to the axles *b*, and b^1, on which the converting vessel *a*, is made to move when required; *c*, *c*, are iron frames secured by bolts *d*, to the masonry foundation, on which the whole apparatus rests; the frame c^1 rises higher than the others, and has plummer blocks, *e*, *e*, bolted to it, in which the shaft *f* revolves; a worm wheel *g* is keyed firmly on the axis *b*, and receives motion from the worm *h*, whenever the handle *i* and shaft *f* are moved round. The interior of the vessel *a* is lined with fire-bricks or fire-stone (as shown at *m*), or it may be lined with any other slow conductor of heat capable of withstanding the high temperature and solvent action of the slags, to which the lining is exposed when the vessel is in use; the bricks or fire-stone may, however, be protected and mended from time to time by moving either of the said plates a^1, which may again be bolted on to the vessel as soon as the new lining is completed, or a man-hole (not shown in the drawings), may be made in one side of the vessel, through which the lining or repairs may be effected without removing the end of the vessel. At *n* there is formed a projecting spout or lip, for the purpose of running out the fluid metal; this lip is made to project from the vessel so far as to bring it in a line with the axis, so that into whatever position the vessel *a* may be moved, the extremity of the lip *n* may retain the same position, or nearly so, and thus allow the stream of metal flowing over it, to fall into the ingot mould, which would not be the case if the axis were placed in a line with the centre of the cylindrical vessel; by reference to Fig. 2, it will be seen, that at m^1 the lining is formed so as to prevent the metal from carrying out with it the slags or other matters, floating on its surface, until after the metal has run out. On each side of the spout *n* (see Fig. 3), there is a curved passage *p*, by means of which the flame and gaseous products evolved during the process may escape, but the splashes of metal thrown up by the jets of air are for the most part prevented from escaping from the vessel by the serpentine form of these outlets. At *r* there is a pipe, which is made to communicate with a blast engine, or with a steam boiler, or it may be made to communicate with a reservoir containing oxygen gas, or a mixture of oxygen with other gaseous fluids, or with any gaseous matter capable of evolving oxygen, any or all of which may be used, either in a cold or heated state, although it is preferred to use atmospheric air at its natural temperature, on account of its cheapness and efficiency. The pipe *r* is fitted at one end of the trunnion or axis b^1, which is made hollow, and is provided with a stuffing-box or other joint, so as to allow the movement of the axis, without interfering with the passage of the air; through it the pipe *s* is also connected with the hollow axis b^1, and has a right angled elbow or bend at its opposite end, and then continues along the outside of the vessel throughout its whole length, and is turned truly on its exterior surface, and has fitted upon it several small branch pipes, *u*, each of which has a T-piece connected to them, which is bored out truly, and made to fit accurately to the exterior of the pipe *s*, so as to admit of the pipe *u* being moved on the pipe *s*, into the position shown by dots in Fig. 2. Along one side of the converting vessel there is a row of square holes, in which small blocks of well-burnt fire-clay are loosely fitted; they are held in position by ramming a little loam well into the joint formed between them and the lining *m*. At one end of these blocks or tuyeres the pipe *u* is fitted by a simple cone joint; the other ends of the tuyere-blocks have several small holes made in them leading into one larger passage, which communicates with the pipe *u*, so that a communication is thus established between numerous points of the interior surface of the converting vessel and the blast-engine, or reservoir of gaseous matters before referred to, and by means of which numerous small jets, or currents of air, &c., may be forced into the converting vessel when required; a sluice-cock on the pipe *r* (not shown in the drawings), enabling the workmen to turn off the supply of air when required. In order that the way in which the pipe *s* and the pipe *u* are arranged may be better understood, a detached view of them is given at Figs. 5 and 6, where it will be seen that the pipe *s* has a hole in it at *x*, which is opposite the orifice of the pipe *u*. Through this hole the air may pass freely when the pipes *u* occupy their ordinary positions; but whenever any of the tuyere-blocks require renewing, the pipe *u* can be turned upon the joint formed at its union with the pipe *s*, as shown by dots in Fig. 2, and in which position the hole *x* in the pipe *s* will be closed, while free access to the tuyere is obtained. Also at Fig. 6 is shown an end view, and at Fig. 7 a longitudinal section of a tuyere-block, where *z*, *z*, show the small apertures through which the air escapes into the metal, all of which passages unite in the larger one *z*, the orifice of which is made conical, so as to fit the end of the pipes *u*. It has also been found that a single outlet in each tuyere-block will answer well in practice, as represented in end elevation at Fig. 8, and in longitudinal section at Fig. 9, where a single parallel passage *y* leads direct from the pipe *u*, into the metal. As these passages sometimes get obstructed, a screw plug *q* is fitted at the back of the elbow of the pipe *u*, which plug may be removed if required, while the apparatus is in use, and a steel rod introduced at the aperture, which should be thrust entirely through the tuyere-block, and any accidental accumulation of matter will be thus removed. By reference to Fig. 1, it will be seen that a boss *v* is formed at the point of junction of two of the webs which are formed on the end plates *a*, of the converting vessel; into this boss a stud is fixed, to which a chain or tension rod may be attached, for the purpose of suspending a counter-balance weight, the chain passing over a pulley, supported by the roof or other convenient part of the building, so that the vessel *a* may be the more easily moved on its axis, by means of the worm-wheel gearing before described.

Bessemer's process has been adopted at some of the largest iron works in England and Wales, and we have seen splendid specimens of iron, and articles made therefrom in numerous forms, from a 22 ft. long single-headed railway bar to batten and tagger plates, so thin that four thicknesses will pass readily into the No. 26 iron wire gauge, or of the thickness of a sheet of ordinary writing paper.

We shall again recur to the subject next month, when we hope to be able to give the results of some very important and practical workings on a large scale, which are now being made.

The Atlantic Telegraph.[*]

"A wire six times the length of the Varna and Balaclava wire, if of the same lateral dimensions, would give thirty-six times the retardation and thirty-six times the slowness of action."

It was known, at the time that these words were placed on record by Prof. Thomson,[†] with direct reference to their practical bearing on the Atlantic project, that the action of the Black Sea Telegraph was inconveniently slow, and its utterance indistinct,—and it was not doubted either by myself or others who heard the above words, that Prof. Thomson meant to give them their full weight, in their literal and practical application.

I will not recapitulate what has been already published in your columns, further than to say that this public and confident avowal of an opinion so discouraging to the progress of submarine telegraphy urged me to a renewed investigation of the subject experimentally, and with the use of instruments of great delicacy and far more free from sources of error than those which I know to have been made use of in the Black Sea. It was upon this practical basis that I joined issue with Prof. Thomson, testing the application of his theory, as stated by himself, to the hard facts of practical telegraphic operations.

The result of my experiments, far from confirming this dictum, went in the opposite direction,—demonstrating, as clearly as such experiments could, the fallacy of this application of the law of the squares.

One or two letters have passed, and in this week's number of your paper I find that, though still maintaining the correctness of the theory —as theory, the whole position for which I originally contended, is conceded by Prof. Thomson. I cannot add to the force of his own words:— "It depends on the nature of the electric operation performed at one extremity of the wire, and on the nature of the test applied at the other extremity, whether or not any *approach to the law of the squares is to be expected* in the observed results," (the italics are his.)

We have then a table, "derived solely from theory," containing in horizontal lines eight series of retardations calculated for various distances and under various conditions of current. Of these, Prof. Thomson says, "Now it will be observed that the law of the squares is fulfilled throughout no horizontal line of the table, excepting the first and last." These two, I may be allowed to add, contain conditions utterly foreign to practical telegraphy:—the one requiring a contact with the battery "during $\frac{1}{1200}$ of a second or any less time,"—the other a contact of over 24 seconds duration. So that, according to Prof. Thomson's own table, in no telegraphic operation at distances ranging from 150 to 2400 miles can the retardation of signals be found in accordance with the sentence with which I commenced this letter.

I must confess it has surprised me that, with the acute powers of reasoning possessed by Prof. Thomson, he has never been led, by the very many "deviations from the law of the squares," and the "serious derangement of the results" which he recognises as arising from the inconstancy of the battery employed, to reason out, from these data, the possibility of attaining, by a modification of the form of current employed, even with the same size of conducting wire, a much higher rate of propagation of the electric impulse, and a corresponding increased rapidity of utterance.

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[*] From the Lond. Athenæum, Nov., 1856.

[†] Meeting of the British Association, Glasgow, Sept., 1855.

Instead of hopelessly endeavoring to make my results correspond with any established theory, I have been contented to prosecute repeated experiments in order that I might *learn* from them; and these facts I have learnt from them:—

First,—that the very "deviation from the law of the squares" do, if rightly understood, open to us a field of research, rich, promising, intensely interesting and practical.

Second,—that the rate of propagation of the electric impulse in submarine wires admits of variation, not merely as an error, but that it is under control, and is—other conditions remaining alike—dependent upon the nature of the electric operation performed to such an extent as to render the adoption of entirely new data necessary, as the basis of any calculations made for the purposes of submarine telegraphs.

Third,—that such data, to be available, should be obtained by the use of instruments either identical or strictly comparable with those that will afterwards be employed in the telegraphic use of the wire.

I may add, that, from my connexion with the Atlantic Telegraph Company, it has been my privilege, as well as my duty, already to commence such an inquiry, that I shall at all times be well pleased to show Prof. Thomson any of the results obtained, and to receive his opinion thereon; and, in my turn, to aid him in any experimental examination of the subject he may wish to make for his own satisfaction upon the Atlantic cable, when sufficiently advanced in its manufacture to admit of such experiments. I am, &c.,

WILDMAN WHITEHOUSE.

*New Process for the Preparation of Ferrocyanide of Potassium.**

By RICHARD BRUNNQUELL.

This process depends on the conversion of ammonia into cyanide of ammonium by ignition with charcoal or carbonaceous matters; and its principal peculiarity consists in the conversion of the cyanide of ammonium thus produced into cyanide of potassium, representing ferrocyanide of potassium, in the humid way. The gas containing ammonia is therefore passed through tubes filled with charcoal and heated to redness; the ammonia is thus converted into cyanide of ammonium, and this into ferrocyanide of potassium by contact with aqueous solutions of potash and suitable iron compounds. The particular advantages of this method are the following:—

1. *The considerable loss of potash and the expense of its recovery are got rid of.*—The potashes are first dissolved in water, by which they are freed from the greater part of the foreign salts. The solution is then treated with a quantity of the cyanide sufficient to convert the greater part of it into ferrocyanide of potassium; this is allowed to crystallize, and the

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* From the Lond. Chem. Gaz., No. 337.

mother-liquor employed without further preparation for the same purpose. Thus we get rid at once of the contamination with silica, &c., and of the necessity of bringing the dissolved potashes again into a solid form, which is of itself a cause of loss.

2. *It becomes possible to replace the potashes by soda, which is much cheaper.*—By the old processes this was often tried in vain, because from the difficult reduction of sodium, the formation of cyanide of sodium in the dry way does not take place so easily, and moreover ferrocyanide of sodium cannot easily be crystallized from such impure solutions as the mother-liquors. The first difficulty is entirely got rid of in its formation in the humid way, and the second may also be overcome, as the solutions are much purer. Ferrocyanide of sodium certainly does not form such beautiful crystals as ferrocyanide of potassium ; but if it can be prepared more cheaply, it will certainly make its way into use, especially as 6 parts of it go as far as 7 of ferrocyanide of potassium, the equivalent of sodium being lower.

3. *Bones may be employed in this process*, their subsidiary product, bone charcoal, covering the cost of the bones and their carbonization, and they would, therefore, furnish the nitrogenous gases for nothing. The gases from the carbonization of bones, are just as rich in ammonia in proportion as those of most other raw materials ; in proportion to their weight, however, bones furnish less ammonia and much less gas.

4. *It is possible to bring back into the manufacture that portion of the ammonia which escapes conversion into cyanogen*, and thus convert it also into cyanogen ; the ammoniacal salts obtained as subsidiary products, may be converted into ferrocyanide of potassium, by mixing them with lime, and adding them to the raw material.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, January 15th, 1857.

John C. Cresson, President, in the chair.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Letters were read from the Regents of the University of the State of New York, and the Metropolitan Mechanic's Institute, Washington City, D. C.

Donations to the Library were presented from the Geological Society, the Statistical Society, and the Commissioners of Patents, London; The Ecole Imperiale des Mines, Paris; M. L. A. H. Latour, N. P., Montreal, C. E.; John W. Harris, Esq., Rocheport, Missouri; Hon. Job R. Tyson, United States Congress; The Kentucky Mechanic's Institute, Louisville, Ky.; The Massachusetts Charitable Mechanic's Institute, Boston, Mass.; Charles B. Penrose, Esq., Pennsylvania Legislature.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer read his statement of receipts and payments for the month of December, also his annual statement for 1856.

The Board of Managers and Standing Committees reported their minutes.

The Annual Report of the Committee on Publications was read.

Candidates for membership in the Institute, (8,) were proposed, and the candidates proposed at the last meeting, (142,) were duly elected.

The Tellers of the Annual Election for Officers, Managers, and Auditors, for the ensuing year, reported the result, when the President declared the following gentlemen duly elected:—

John C. Cresson, President.

John Agnew,
Matthias W. Baldwin, } Vice Presidents.

Isaac B. Garrigues, Recording Secretary.

Frederick Fraley, Corresponding Secretary.

John F. Frazer, Treasurer.

MANAGERS.

Samuel V. Merrick,
Thomas Fletcher,
Abraham Miller,
John C. Trautwine,
John H. Towne,
Edwin Greble,
David S. Brown,
Thomas S. Stewart,
Owen Evans,
Alan Wood,
John E. Addicks,
Isaac S. Williams,
George W. Conarroe
Thos. J. Weygandt,
Joseph J. Barras,
Joseph Harrison, Jr.,
George Erety,
Evans Rogers,
Robert Cornelius,
Lawrence Johnson,
George C. Howard,
Jacob Weaver,
William Sellers,
James H. Bryson.

AUDITORS.

Samuel Mason,
James H. Cresson,
Samuel B. Finch.

At a meeting of the Board of Managers, held January 21st, 1857, the following officers were elected for the ensuing year:

Thomas J. Weygandt, Chairman.

Isaac S. Williams,
Owen Evans, } Curators.

BIBLIOGRAPHICAL NOTICES.

Hand Book of Inorganic Chemistry. By Wm. Gregory; Fourth American from the third English edition; to which is added the *Physics of Chemistry.* By J. Milton Sanders, M. D., New York: A. S. Barnes & Co. 1857. 8vo. pp. 421.

Hand Book of Organic Chemistry. By Wm. Gregory, M. D.; Fourth American from the fourth London edition. Edited by J. Milton Sanders, M. D., New York: Barnes, 1857. 8vo. pp. 481.

There is probably no branch of Physical Science upon which it is at the present time more difficult to write a satisfactory treatise, than chemistry. The beautiful simplicity of the theories established by Lavoisier and his contemporaries has long since disappeared, under the accumulation of facts heaped up by the multitude of observers whom the beauty of the subject and its practical importance have attracted; and the sad error of attempting to alter the nomenclature to suit each varying hypothesis, has led to difficulty in even reading understandingly the works of the modern theorists. The ancient Assyrians are said to have had some dozen forms for each of the letters of their alphabet, and it appears as though the student of chemistry in the next century would be obliged to remember about as many formulæ for the substances most familiar to him. In consequence of these difficulties, modern works on chemistry generally divide themselves into two classes: one of which, are devoted to general theoretical speculations, and discuss the facts only as they have a bearing upon the views which are propounded; while the other, devoted rather to practical utility, are intended to serve as a reservoir for the facts, and regard theory only as a means of classification by which these facts may be remembered. The science wants another Lavoisier to recombine these conflicting elements, but no such has as yet indicated his coming; chemistry is still in its essence an empirical science, and so many plausible hypotheses may be suggested to account for its phenomena, while so little of absolute demonstration is applicable to its theories, that authority is generally more available than argument, in settling belief, and simplicity rather than certainty is the standard of excellence.

The names of the treatises now under our consideration, indicate that they belong to the second class, and are intended to present rather a mass of chemical facts conveniently arranged for reference, than an attempt at a true theory of the science. Viewed in this light, we regard Dr. Gregory's books as perhaps the most useful which have of late years issued from the English press; and as furnishing to the student, whose attention to chemistry is incidental to the prosecution of some other profession, the medical-man, the agriculturist, or the manufacturer, a very excellent compendium, in which he will find the most of the facts of value to him, and the views which will suggest to him their applications. It is comprehensive, lucid, terse and practical, and although not a substitute to the chemist for more elaborate treatises, such as those of Berzelius and others, will still always be valuable in the laboratory.

Of the labors of the American Editor we cannot speak so favorably. It might have been much worse, for he has shown industry; but it ought to have been better, for it indicates a want of judgment, and in many cases an ignorance of the latest and best authorities. Why quote Rumford's comparatively rough experiments, when we have so many more accurate determinations since; and why, while Regnault's tables are several times given, retain the number, 0.870, given by Delaroche and Berard, as the specific heat of vapor of water, after Regnault has shown that it is entirely inadmissible? or what confidence will a reader put in statements which he cannot verify, when he finds the following, which we quote from a page opened at random: "When water at the temperature of 39° Fah. is either heated or cooled, it expands regularly for the same number of degrees, either added or subtracted: *hence, when cooled to* 36°, *it rises to the same point as when heated to* 44°. *At* 32° *it stands at the* *same point as at* 48°, *and at* 20° *at the same point as at* 60°." The next sentence assigns 39·2° instead of 39° as the temperature of maximum density, on the authority of Dr. Hope, and perhaps farther research might have modified the number still more. Much of the Physics presents the same faults of a want of familiarity with what has been recently done, and not yet found its way into popular treatises. Has Dr. Sanders ever heard of Foucault's performance of Arago's test experiment as to the nature of light? If he has, how could he say that "its phenomena are explained either on the supposition that it is a material fluid," &c.; or by whom is it now, that, "heat or caloric is supposed to be that substance, whose entrance into the body occasions the sensation of *heat* or warmth?"

As to the Supplement, we must content ourselves with fully endorsing the expression of opinion in the Preface, that much matter has been left out equally important with that given; and recommending that in the next edition, the name of the author of the Homological table should be inserted in its title. The work is well printed, of convenient size and good typography.

Chemical and Pharmaceutical Manipulations: a Manual of the Mechanical and Chemico-Mechanical Operations of the Laboratory. By CAMPBELL MORFIT and CLARENCE MORFIT; with 575 illustrations. 8 vo. pp. 626, Philadelphia: Lindsay & Blakiston, 1857.

The work of the Messrs. Morfit, which we noticed in our Journal at the time of its first appearance, has now reached a second edition; and this fact itself, is perhaps not bad evidence that it possesses value. The present edition is profusely illustrated, which will add to its attraction as well as to its value, although perhaps in some of the larger cuts undue prominence has been given to the pattern of the operator's dressing-gown, at the expense of the details of the apparatus. By the way, we are sorry to see these Germanisms in the book. Does Prof. Morfit operate in his laboratory in a morning-gown? If not, why adopt from foreign lands such puerilities. Nor are we sure that the enlargement of the work is productive of any intrinsic advantage. The chemical student who wants a work upon manipulation, does not require from it a philosophical treatise on the construction of the instruments, but upon their use; and the chemical professor who is perfectly familiar with the manipulation and adjustment of the barometer and the electrical machine, may fail to do himself full credit when he undertakes to lecture on their theory. The work before us has been enlarged to a somewhat cumbersome size, and we cannot but think that its sale would be promoted, and its usefulness not diminished, if much not relating to the subject of the book, as stated in the title, had been omitted. The work is dedicated to Prof. John Henry Alexander, and the connexion of his name with it will, to those who know him, be another reason for expecting from it a high degree of accuracy of statement and scientific merit.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

MARCH, 1857.

CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

On the Improvement of the Ohio River. By Ellwood Morris, Civ. Eng.

(Continued from page 83.)

III. *Of Low Dams and Chutes, or Pool and Current Navigation.*

The author of this plan is Herman Haupt, Esq., Civil Engineer, (a gentleman of well deserved eminence in certain walks of the profession,) who has developed it, (though not very definitely,) in his pamphlet entitled "A Consideration of the Plans proposed for the Improvement of the Ohio River, 1855," summing up on page 44, in the following words, to wit:—

"That the true plan for the best improvement of the navigation, differs from any that has yet been proposed, and consists of a succession of pools formed by low dams of from 6 to 10 feet, connected by open channels not less than 200 feet wide, through which the water will flow free from locks, or any other obstruction, at the moderate velocity of two miles per hour."

And on page 42, he determines the fall necessary to give that velocity in a straight and uniform channel 200 feet wide to be, only one foot per mile, which "gives for the velocity in feet per second, 3·13."

now, $\frac{3\cdot13\times60\times60}{5280}=2\frac{1}{10}$ miles per hour, from which the velocity is assumed in round numbers at 2 miles per hour. This proposed plan, so far as it can be gathered from the pamphlet quoted, is to erect low dams (*each of four feet lift*) across the river at suitable points, extending from one shore within, say, 200 feet of the other; and then to connect the pools of these dams, or discontinuous wiers, by means of open channels or *chutes* of gentle slope (one foot per mile) formed by erecting or continuing from the end or opening of one dam, a bank 10 feet high lengthwise of the river, extending, on an average, 4 miles down-stream—this bank being placed 200 feet from one shore, and protected by a riprap or slope wall.

These dams would have a total height of 10 feet above channel-bottom, from which the depth proposed for the navigation, 6 feet, being deducted, leaves for *the lift* of each dam=4 feet.

The calculations of the pamphlet for the plan preferred, are evidently made upon the supposition of a straight and uniform section in the chute, *and a prolongation of one mile of chute for each foot of lift of dam.*

But the bank forming the chute, running only an average parallel to the irregular shore, will intercept both unequal widths and unequal depths, and, therefore, the calculations of permanent *regimen* will not strictly apply.

To make these chutes answer the calculations, all the sides of the water perimeter should be impervious; the chutes should have both uniform depth and uniform breadth, so as to produce a uniform section (as assumed in the pamphlet), or rather, one properly graduated in breadth, so as to maintain an uniform depth with a given inclination and supply of water, allowing both for friction and leakage. These conditions would require a regulation of the shore line also, so as to be nearly equivalent to two banks and a permanent bottom of regular slope, which does not seem to be provided for in the plan as laid down, nor is any account taken of the crooked line required to follow the shore.

The whole descent of the Ohio River, (the falls excepted,) being, say, 400 feet, this plan would require about 100 *dams* each of four feet lift, and 400 lineal miles of *chutes* to overcome them!

This assumes that to leave a proper margin of depth for the accumulation of deposits at the foot of each chute, an extra depth would be required, equivalent, at least in practice, to each dam setting back 6 feet against the next, so that we could hardly expect to avail ourselves of the fall of the chutes, to reduce the number of dams materially, though the pamphlet proposes to do so.

Besides, these dams would be so numerous, that to render the proposed navigation available to both shores, 6 feet deep must be maintained throughout the pools: *for if not*, one-half of the length of the river shores opposite to the chutes, or 400 miles lineal of one side, would be deprived of the benefits of the full depth proposed.

The Ohio River is now over 1000 feet wide, on 6 feet deep, and with that depth of water, *procured in the natural way*, makes a truly beautiful and useful navigation, one equally beneficial to both shores, and of a width not more than adequate to the transaction of the multifarious business which floats upon its bosom,—where we will often see within a few yards of each other, enormous rafts and clumsy coal boats descending the stream, while steamboats are passing in both directions; *all these* this plan proposes for a length of 400 miles, to crowd into crooked and narrow "*chutes*" of the very restricted and inadequate breadth of 200 feet!

A width in which it would be literally impossible for an ordinary steamboat to round to, or even to turn around!

It is well known that *descending steamboats*, upon rivers like the Ohio, can only land on the shores *by rounding-to*, for which purpose they are specially planned, and carry their freight forward to land from the bow; but as it would be vain for any ordinary steamboat to attempt to round to in a *chute* only 200 feet wide, it necessarily follows, that during the low water season, 400 miles of the inner shore along these chutes, would be cut off from all communication with *descending boats*.

Now, as the pamphlet proposes to save dams by reducing depth outside the chutes, thus depriving the opposite or outer shore of the full benefit of the improvement, and as the chutes themselves would deprive the shores they follow of all communication with *descending* steamers, while the height of their outer banks would cut off the other side at low water, or at any rate, force all *ascending* trade from that outer shore *to descend first*, to the outfalls of the chutes: we have finally, about 800 miles of the river border, deprived in whole, or part, of the benefits of the proposed navigation during the whole low water season, by this miscalled *improvement!*

To each dam of four feet lift, would succeed a chute 4 miles long, to be formed by an earthen bank in the river some 10 feet high. This bank would necessarily have to follow the sinuosities of the shore, and if built of earth and stone, as proposed, could hardly fail to lose its salient angles or convex bends in every heavy flood.

The idea advanced in the pamphlet, that a bank 10 feet high and 4 miles long, (at each dam,) built of earth in the bed of the Ohio River, could be "*effectually protected*" by "a coating of stone placed by hand on the slopes," will hardly be considered as a serious proposition by those who know this river, and are familiar with such structures. That in many places these banks, notwithstanding their "*coating of stone*," would be demolished by every deep flood, is too certain to require argumentative proof.

The only safe formation of the chutes, would be to make each outer bank a continuation of its dam; nothing less secure would be likely to answer, because the chute bank would be less favorably situated in some respects than the dam itself; for the abutments of dams, which are always parallel to the stream, are often swept away, while the dams themselves remain undisturbed; we have, then, an entirely new feature in this plan (imposed by considerations of durability,) *and in this shape it proposes to construct* 100 *dams longitudinally of the bed of the Ohio River, each* 4 *miles long and* 10 *feet high!*

But there are other difficulties. The Ohio is continually receiving tributaries, numbering in all, nearly 200 large and small, between Pittsburgh and Cairo. Many of these would necessarily be intercepted by the chutes, yet the pamphlet does not attempt to show how this is to be managed, nor is it easy to do so. Now, these tributaries often rise high when the Ohio River is low, and rush perpendicularly across its channel. The annoyance given in this way by the Licking River, at Cincinnati, is well known. In such case the earthen bank proposed for the chutes would be entirely destroyed for some distance, and this could hardly fail to be a frequent occurrence, as every thundergust upon a small tributary, intercepted by a chute, might produce it, and suspend the navigation.

As to how these chutes are to be conducted past such rivers as the Hockhocking, the Muskingum, the two Kenawhas, the Sciota, &c., of the Upper Ohio, not to mention the great tributaries in its lower course, like the Tennessee and Cumberland, the pamphlet is entirely silent—though these questions are far from being unimportant, and could not fail to arise on some sections of a *chute*, having 400 miles of aggregate length.

The fall of the chutes proposed in the pamphlet, is fixed at *one foot per mile;* but this is only about the same as the average fall of the river between Pittsburgh and Wheeling, and hence, throughout this distance, the channel must either be continuous, only 200 feet wide, cutting off one shore entirely at low water, or else some other expedient would be necessary; and for this the pamphlet provides, by admitting on page 47, that here, "the assistance of reservoirs or the construction of a portion of slackwater would be indispensable;" but reservoirs adequate to maintain 6 feet deep above Wheeling, would render dams and chutes entirely unnecessary below that point; while slackwater would destroy or force the relocation of the railroads just finished along the right bank, so that not only private, but *corporate property* would be overwhelmed in a common damage by the plan proposed.

We will now consider the linear position of the banks of these chutes, and their effect in low freshets; placed lengthwise in the river in sections aggregating 400 miles in length, with a height of ten feet, they may be regarded as a low island of that length, submerged by all ordinary freshets, and forming in some stages of the water, one of the most dangerous obstructions it is possible to conceive of. The idea of placing 100 dangerous artificial bars, each four miles long, in the Ohio River, within 200 feet of one shore, and then attempting in freshets to indicate by "*buoys*" the position of these sunken banks, 400 miles long, and only 10 feet wide, in such a river as the Ohio, is hardly serious; and yet the pamphlet proposes merely *these buoys*, or the shore line dimly seen by night as an adequate guide, (when the chute banks are submerged,) to find a crooked and narrow channel only 200 feet wide, or to pick it out in fog or darkness from a uniform expanse of water six times that width! But neither buoys nor shore line, could prevent the current at curves and the mouths of creeks, from sweeping coal-boats, rafts, and even steamboats occasionally, upon these long and dangerous artificial bars, *and effectually wrecking them there.*

Although this plan will not augment the floods to the extent that would be caused by the higher dams proposed for a slackwater, it must nevertheless be remembered, that the proposition is at low water to keep up artificially, a 6 feet depth in the river instead of 2 feet, and therefore a freshet would necessarily find the channel of the river already full, and be compelled to flow over *an underline*, raised 4 feet higher than if these dams and chutes were away. Again, the positive obstacle at each dam, would be 10 feet high from the channel-bottom, and though a discontinuous wier (owing to the chute,) it would, nevertheless, have a material effect upon the surface line of freshets. In point of fact, there can be no doubt that some increased rise would be caused in floods by this system of dams and chutes, and though it may be difficult to assign a precise limit to it, yet from analogy, we can scarcely expect it to be less than 3 to 5 feet, while it may be more. This may seem small to many, but would be deemed more than enough by those whose property was periled by it.

We have seen, that it is proposed by these chutes to reduce the navigable width of the Ohio River, from an average of about a quarter of a mile, down to only 200 feet for 400 miles of its course, or nearly half its length. We will now add, that while this comparatively petty canal, is utterly inadequate for the manœuvres of steamboats, a single pair of coal-boats sunk in it by one of the numerous collisions of which this plan could hardly fail to be prolific, would suspend the navigation for days, if indeed it did not produce other wrecks, and longer continued delay.

While the slack-water plan, at least, proposed to give us in the pools a noble navigation a quarter of a mile wide, of an ample depth, and a general character, going far to compensate us for delay at the locks, and other evils, and required the aid of reservoirs *only*,—the plan before us not only proposes to reduce this fine river, to a comparatively petty canal for nearly half its length, but is so incomplete within itself, *as to require the aid of slack-water and of reservoirs both!*

We will now notice another effect that may be expected from the proposed plan of dams and chutes, or pool and current navigation—it is *the formation of bars at the outfalls of the chutes.* By this plan the present uniform current of the Ohio, would be *broken and deadened*, by the pools in sections amounting to about half the length of the River, while on the other half, the velocity of the current would be *more than doubled:*—in technical language, *the regimen of the river would be destroyed;* the result of this is certain, and may be best explained in the words of an elementary work on Civil Engineering, to wit:—

"Bars are formed at those points, where from any cause the velocity of the current receives a sudden check. The particles suspended in the water, or borne along over the bottom of the bed by the current, are deposited at these points, and continue to accumulate, until by the gradual filling of the bed, the water acquires sufficient velocity to bear farther on the particles that reach the bar, when the river acquires and retains a fixed regimen, until disturbed by some new cause."—*Mahan*, p. 341, Ed. 1853.

In conformity to the above elementary principle, *bars* would inevitably accumulate at the outfalls of all the *chutes*, (100 in number), and form *obstructions*, calling for incessant *dredging.*

We will now refer to a case where this plan has been actually tested, though it may not have been known to the author of the pamphlet—the plan of low dams and chutes, as proposed, has already, upon a working scale, been put in action upon the Ohio River, by the Government Engineers, *and with a want of success too signal to encourage new trials.*

It is at the well known spot called *Buffington's Island.* Here the River divides itself into two channels of very unequal size, the main body of the stream going on the Virginia side of the island, while along the Ohio shore, is a uniform and narrow channel, for the most part quite direct, *forming a chute, in fact, and so called by the boatmen.*

The island itself is about a mile long, forming one bank of "*the chute*," the Ohio shore the other. The chute itself is about 200 feet wide, and the main channel of the River is stopped by "*a low dam*," extending from the island to the Virginia side. It forms, in truth, precisely what is described in the pamphlet, "*a low dam and chute.*" It is a fair experiment upon a working scale, and if there were any thing useful in the plan, it would necessarily show at this place, *some beneficial result;* but the fact is just the reverse. *Buffington's Island*, (as the whole arrangement here is briefly called by the boatmen), is well known as forming one of the most serious obstructions in the Ohio River, and it would create no little excitement amongst the river men, to learn that a civil engineer had gravely proposed *artificially, to repeat this celebrated obstacle in a hundred places!*

The writer cannot be mistaken in the topography of *Buffington's Island*, having, in company with a hundred other passengers, spent one miserable day, promenading in a snow storm along the banks of "*the chute*," disconsolately viewing a dozen steamboats grounded in it, or glancing anxiously at another steamer, which had borne us with little difficulty from Pittsburgh, but now lay stranded upon the "*low dam*," where she remained for three days.

In discussing the plan of low dams and chutes, the pamphlet assumes, "that the depth of ordinary low water upon Wheeling Bar is 2 feet; but it is occasionally much less than that. Thus in the year 1838 alone, it appears there were 93 days when the River at Wheeling stood at 2 *feet or under*, while for 28 days it stood at *one foot or under!*

Now, as works of this sort must be planned for extreme cases, in order to be constantly useful, it is necessary to assume low water on Wheeling Bar at what it really is, *or one foot only.*

This would make a material difference in the pamphlet calculations, render a much greater amount of assistance necessary from reservoirs, and would detract considerably from the apparent feasibility of the plan before us.

The plan of construction of the low dams and chutes, is much too obscurely stated in the pamphlet to justify a detailed estimate of cost, and its author indeed seems to have waived that important consideration, by not giving us the value of his unit of comparison,—"an equal length of railroad."

The expense, however, of substantial structures for dams and chutes, would be very great, and with the *slack-water* above Wheeling, and the *reservoirs* required as auxiliaries, would not probably fall short of *twenty millions of dollars.*

But it does not appear worth while to prolong this subject, and we will now conclude by briefly summing up the chief objections to an attempt to improve the Ohio River Navigation, by means of "*low dams and chutes.*"

1. That this plan is crude and imperfect, requiring the aid of reservoirs and slack-water both, and yet depriving in part of the benefits proposed, about 800 miles of river shore.

2. That it proposes to contract the channel for 400 miles in all, to a width of only 200 feet, which is less than the length of an ordinary steamboat, and in which it would be impossible for them either to turn, or round to.

3. That it proposes in connexion with these insufficient channels, to erect 100 dams across the River 10 feet high, and to form chutes at each by prolonging a wing down-stream 4 miles long and also 10 feet high;

these wings or chute banks, each 4 miles long, forming most dangerous artificial bars in low freshets at 100 places.

4. That while proposing artificial obstructions in the channel, both transversely and longitudinally, it promises to create 100 natural bars besides.

5. That it will produce an augmentation of the floods, of from 3 to 5 feet, or more, in all probability.

6. That it has been already tried upon a working scale at *Buffington's Island*, and has entirely failed in its design.

7. That it would probably cost twenty millions of dollars, if substantially constructed.

The pamphlet we have referred to, discusses also two other plans—high dams with retaining reservoirs, and low dams with retaining reservoirs. In these there is nothing new, (except in the unwise proposition to place them in the main River,) for they have been already suggested by Mr. Ellet to be placed upon the *navigable* tributaries of the Ohio, and to form there "Regulating Reservoirs."

In this way they can probably be made serviceable, but in the main channel of the Ohio they would be so very objectionable, that it is to be hoped the plan will not be seriously entertained.

Dams with retaining reservoirs are not new to the engineering profession, having long been used, and it is not necessary to go into an examination of their merits at this time.

Concluding Remarks.

We have now briefly examined the leading plans proposed for the improvement of the Ohio River Navigation. We find that the Reservoir Plan is incomparably superior to any of the others, and we have also seen the singular fact admitted by the advocates of the rival plans, that neither of the others are likely to answer any good purpose, *without assistance from reservoirs.*

Here, then, is common ground, and as all the plans require reservoirs, *is it not manifestly the best policy to build those reservoirs first?*

It is admitted they will be needed as auxiliaries even by a slack-water navigation, whilst on the other hand it is confidently argued, that reservoirs *alone*, are adequate for the improvement of the Ohio River

The part of prudence, then, is to build the reservoirs *first*, and if they fail to answer their intended purpose as *principals*, there can at least be no doubt of their utility as *auxiliaries*. Having, therefore, by the construction of reservoirs obtained the means of controlling or mitigating the floods, *the slack-water navigation can be carried out if it should ever be found necessary.*

In this manner nothing would be lost, we should be commencing at the right end, and our progress would be uniformly onward, until a permanent improvement of this noble River, was fully and satisfactorily accomplished.

On the other hand, if a slackwater navigation, or low dams and chutes, were built and *failed*, it would be a most expensive work to remove these obstructions from the channel, besides incurring a dead loss of the whole original outlay, and being compelled to go back *to reservoirs at last!*

To construct these reservoirs for the improvement of a River in which (adding Missouri,) the people of *seven* powerful states are interested, we must depend upon the action of the General Government, with the concurrence of the States of Virginia and Pennsylvania alone, whose right of eminent domain would have to be invoked to obtain possession of the reservoir sites on making adequate compensation to the owners.

After the construction of these reservoirs, should it be deemed advisable to employ them only *as auxiliaries* to a slack-water navigation, such navigation can be left to a corporation created by the concurrent action of the bordering States, and strictly limited in their charges.

Appendix.

Since the above was in type, the writer has had placed in his hands, a pamphlet "On the Improvement of the Ohio River," written by W. Milnor Roberts, Esq., Civ. Eng., in which he announces himself as "an advocate of the system of locks and dams on the Ohio River," which he is said to have proposed as early "as the year 1839," and certainly no better sponsor for it could be desired, since the skill and experience of that gentleman as a Civil Engineer cannot be doubted.

This slashing pamphlet is a skilful and studied attack upon the plans and propositions originated by Mr. Ellet, and raises questions of fact which a survey *alone* can settle, though wisely admitting the *practicability* of the Reservoir Plan.

Between these able engineers, the writer is not at all inclined to interpose, but nevertheless, it appears necessary to notice briefly here, a portion of this new matter.

Mr. Roberts proposes dams of 8 feet lift, and to clear the slack-water plan of the just imputation of embarrassing if not destroying the descending navigation, "for arks, rafts, &c.," states that his plan "contemplated the introduction of *sluice ways* which could be easily navigated by arks and rafts," but he has evidently overlooked the important fact, that these arks when laden with coal, *draw six feet water*, or actually require more water for their floatation than the steamboats do!

From this little fact, an important consequence flows, for if these sluiceways or chutes are so arranged as to admit the *safe* passage of those burdensome but frail boxes of pine lumber, called "*coal arks*," *which draw six feet of water*, it is clear, that they must also answer for the transit of the stronger steamboat which never draws so much; *and hence the locks would be useless.* In this shape, this plan, in fact, becomes the plan of Mr. Haupt, that of "low dams and chutes," noticed in the 3d division above—the objections to which are insurmountable.

While Mr. Roberts proposes to provide for the descending navigation in his slack-water plan, which indeed is indispensable in any plan, he attempts to show that reservoirs upon the great affluents of the Ohio will necessarily destroy the very important *lumber trade*, which now comes from the forests near their sources: but, in this, it appears to the writer, he entirely fails.

For the establishment of reservoirs upon the great affluents, far from prejudicing the lumber trade, will confer a benefit on it, by forming large and quiet pools to collect it together; acting, in fact, like the *Booms*, so often employed upon our lumber rivers.

Once collected within the pools of the reservoirs, both logs and lumber would be floated from them, *through the reservoir dams*, at periodic seasons, by means of substantial contrivances, which any skilful engineer charged with these works will know how to plan, construct, and operate with entire success.

That the lumber will only be passed down at *stated periods*, forms no objection: since, with unobstructed streams, it is only *occasionally*, and at very *uncertain* times, that it can now be run at all.

There are *five* very important objections to the "system of locks and dams on the Ohio River," which Mr. Roberts has studiously, if not wisely, declined to meet; any one of the first four of these is fatal to the slackwater plan, and when we consider that it is proposed to carry it out under the direction of *a corporation*, the fifth is fatal too, to wit:

1. The augmentation of freshets by slack-water pools.
2. The increased obstruction from ice.
3. The damages to town and country property.
4. The expense of maintenance.
5. The tolls necessary to be charged for maintenance alone, if not for interest, and corporate profits.

And we may add that not the least of the legitimate objections to Mr. Roberts' "system of locks and dams on the Ohio River," is, that it is proposed to carry it out by means of *an incorporated body*, which is even now soliciting from the Congress of the United States, a grant of land ostensibly to effect this so-called improvement, but really using the popular name of the Ohio River to cover *a mere land speculation.*

A speculation like some of those now in progress in the north-west, based upon railroad schemes in the wilderness, the operators in which, do not hesitate to avow to each other, "*that they care nothing about the railroads, it is the Government lands they are after!*"

So it is to be apprehended, that a grant of Government lands to the Ohio River Corporation will end, not in an improvement of the Ohio River, *but in the loss of the lands to the Country.*

For the Journal of the Franklin Institute.

A simple method of finding the Helicoidal Surface of a Screw Propeller, and the Practical Development of such Surface upon a Plane. By James H. Warner, Eng. Corps., U. S. N.

From a great variety of fantastic designs, the screw propeller has been so far improved that we may with propriety consider a uniform, or *true* screw, the rule, and all other forms an exception.

Griffith's screw is perhaps the only important deviation from ordinary practice that has other than an ideal existence, and his screw is made uniform for a given pitch, whilst the blades are movable to a certain extent in order to increase or diminish the pitch. But this form is limited to cases where the screw can be easily dismounted by hoisting it out of position, a system of arrangement almost exclusively confined to auxiliary steam vessels for naval service.

Aside from the importance of ascertaining the best form and dimension, there are other points connected with the design and construction of a screw, which claim the attention of the mechanical engineer, and the object of this paper is to furnish a simple suggestion with reference to the helical surface of a screw, and the development of such surface upon a plane.

The operation here described is but an adaptation of the centrobaric principle, or the "Guldinus" properties of bodies, as stated in the following proposition:

> "If any straight or curved line, or plane surface bounded by curved lines, revolve about an axis situated in the same plane with the lines or surfaces, the surface or solid thus generated will be respectively equal to a surface or solid whose base is equal to the given line or surface, and whose height is equal to the arc described by the centre of quantity of the generating line or surface."

Let B D, fig. 2, Plate III, be a circle, of which B E is the radius. Now, then, if the line B E revolve about the point E, the extremity will describe the circumference whilst the line itself will describe the area of the circle. From the principles of mechanics, we know the centre of gravity of a straight line lies in its centre; then bisecting the line B E gives the point *a*, which with the radius *a* E describes the circumference *a b*. Hence from the above proposition, the area of this circle is equal to a rectangle of which the line B E is the base, and the circumference *a b* the height; or in other words, the area of a circle is equal to the product of the radius B E, into the distance traversed by its centre of gravity.

Applying this to the screw, let B D be the circumference, and B E the radius, which, in this connexion, may be called the *generatrix;* whilst the point B describes the circumference, the line B E moves in the direction of its axis a distance equal to the pitch, generating a twisted or helical instead of a plane surface, and the development of the path traced by the point B is the hypothenuse of a right angled triangle (fig. 2), of which the circumference B D is the base, and the pitch A B the perpendicular. In like manner the helical path of the point *a* is the hypothenuse of a similar triangle of which the circumference *a b* is the base, and the pitch a perpendicular, whence the area of one thread for one convolution is equal to a rectangle, the base of which is the radius, and whose height is equal to the hypothenuse A I. That is to say, multiply the radius of the screw by the development of its centre of gravity or the hypothenuse A I, for the whole of the area thread, and this product again multiplied by the mean fraction of pitch used gives the area of such fractional part. This product includes the whole surface from axis to periphery, consequently, to obtain the effective area that portion within the hub must be deducted. Referring to fig. 2,

A B = Pitch of screw.
B D = Circumference of do.
A D = Development of exterior helix.
A C = " " of hub.
A I = Helical path of centre of gravity of radius of screw.
A 2 = " " " hub.
R = Radius of screw. R' = Radius of hub.
F = Mean fraction of pitch.

$$\text{Then } \sqrt{AB^2 + BI^2} = AI.$$

$$\text{and } \sqrt{AB^2 + B2^2} = A2.$$

Whence

$(R \times AI) - (R^1 \times A2) =$ area of thread for one convolution.

or

$(R \times AI) - (R^1 \times A2) \times F =$ effective area for any fractional part.

Applying to this the screw of the U. S. Steam Frigate, "*Minnesota*," having the following dimensions:—

Diameter, . .	17 feet 4 inches.
Pitch, . .	23 "
Length, . .	3 " 6 "
Diameter of hub, .	2 " (mean.)
Number of blades, .	2

We have,

$AB = 23$ feet. $B2 = 3{\cdot}1416$ feet.
$BD = 54{\cdot}44$ " $BC = 6{\cdot}283$ "
$AD = 59{\cdot}09$ " $BI = 27{\cdot}22$ "
$AC = 23{\cdot}84$ " $R = 8{\cdot}66$ "
$R^1 = 1$ foot. $F = \frac{3\cdot5}{23} \times 2 = {\cdot}3042$

$$AI = \sqrt{23^2 + 27{\cdot}22^2} = 35{\cdot}64.$$

$$A2 = \sqrt{23^2 + 3{\cdot}1416^2} = 22{\cdot}2.$$

Whence,

$(8{\cdot}66 \times 35{\cdot}64) - (1 \times 22{\cdot}2) = 286{\cdot}6$ square feet area for one full thread.

or

$(8{\cdot}66 \times 35{\cdot}64) - (1 \times 22{\cdot}2) \times {\cdot}3042 = 87{\cdot}188$ sq. feet area of two blades.

This operation admits of similar application when the pitch expands radially or in the direction of its axis, and with either an *oblique* or *curved* generatrix.

The development of one blade of the screw cited in the preceding example is shown in fig. 3. The angle of this blade at periphery is 22° 54′ 10″, increasing gradually from thence to the axis or 90°, at the hub it is 74° 43′ 14″.

If a cylinder be cut at any other than a right angle with its axis, the section will present an elliptic or rather an oval figure, consequently, if we observe the exterior helix of a screw from a point perpendicular to its direction, the curve of the extremity of the blade will be similar to that of the transverse side of a cylindrical section cut at a corresponding angle, and the same would result for any other point, lying in a line perpendicular to the axis passing through the centre of the blade, the curve changing with the angle.

The diameter of this screw is 17·33 feet, and the angle at periphery, 22° 54′ 10″; hence, to obtain a curve of the blade at this point, we have simply to describe that of a cylindrical section cut at this angle, of which the perpendicular line through the centre of the blade, or the radius, is the minor axis, and the diagonal cutting the sides of the cylinder the major axis.

The radius is 8 feet 8 inches, which I have divided into 8 spaces of 1 foot each, and one of 8 inches, and have drawn the curved helices, 1, 2, 3, 4, 5, &c., corresponding to the sections of cylinders, 2, 4, 6, 8, 10, &c., feet diameter.

The length of the helices were calculated by the formula,

$$\sqrt{2\,\pi\,\text{R}^2+\text{Pitch}^2}\times\frac{\text{length}}{\text{pitch.}}$$

These lengths measured upon the curves give the points 1, 2, 3, 4, 5, &c., through which the line is traced, indicating the shape of the developed blade. The horizontal dotted lines represent the respective semi-major axes and the vertical dotted lines the radii or semi-minor axes.

I have arranged the calculations from which the diagram was drawn in the following tabular form, and which, with the exception of column G, requires no further explanation.

Diameter.	Circumference.	Hypothenuse.	Angles.	Semi-axis (major.)	Semi-axis (minor)	Radius of curve.	Helix.
A	B	C	D	E	F	G	H
	$A\times 3{\cdot}1416$	$\sqrt{B^2+23^2}$	$\frac{B}{23}=\tan.$	$\frac{\text{Sec. }D\times B}{2}$	$\frac{A}{2}$		$C\times{\cdot}1521$
feet.	feet.	feet.		feet.	feet.	feet.	feet.
2	6·283	23·84	74° 43′ 14″	3·80	1	13·514	3·626
4	12·56	26·20	61° 21′ 39″	4·17	2	8·854	4·000
6	18·84	29·74	50° 40′ 38″	4·73	3	8·125	4·524
8	25·13	33·66	42° 27′ 53″	5·42	4	7·375	5·119
10	31·41	38·48	36° 12′ 46″	6·20	5	7·604	5·853
12	37·69	44·15	31° 23′ 12″	7·02	6	8·166	6·715
14	43·98	49·63	27° 36′ 26″	7·90	7	8·958	7·548
16	50·26	50·26	24° 35′ 21″	8·74	8	9·625	8·406
17·33	54·44	59·09	22° 54′ 10″	9·36	8·66	10·187	9·000

The radii of the curved helices were obtained by means of a subsidiary diagram similar to fig. 4., as follows:—Draw two lines *j o*, *j n*, at any convenient angle, make *j k* and *j m* respectively equal to the semi-axis, then with the distance *j k* and *j m*, cut *j n* in *l* and *n*; join *l* and *m*, and from the point *n* draw *n o* parallel to *l m*, the distance *j o* will be the radius of a circular arc which will nearly coincide with an elliptic curve to a greater extent than the helix of the blade of an ordinary screw. This radius may be otherwise and perhaps more conveniently obtained, as follows:—join the extremity of the two axes by the diagonal *a f*, fig. 3, upon which, from the point *b* of the rectangle *a b f c*, let fall a perpendicular *b h* extended so as to intersect the vertical line *a c*, gives the point from which the curve is drawn.

Fig. 5, is simply a *working sketch* showing thickness of metal &c., and from which it is apparent that lines traced through the extremities of helices measured upon straight lines do not approximate to the true shape of the blade.

Fig. 3.

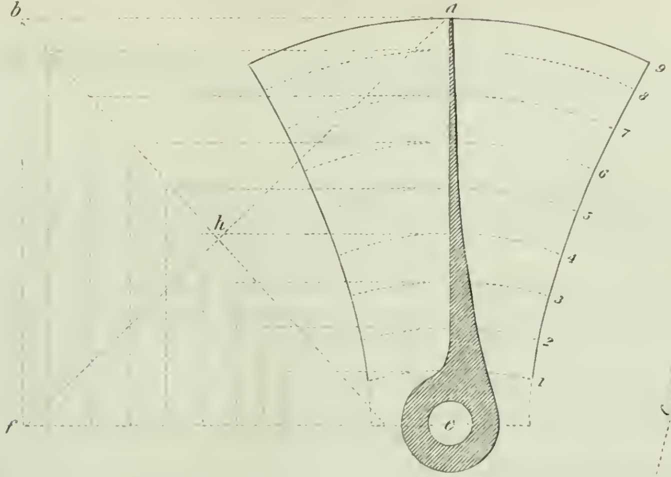
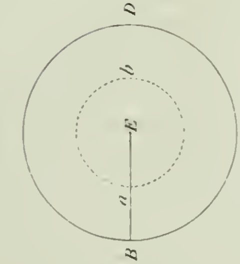


Fig. 1.



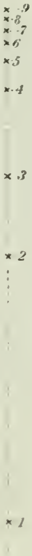


Fig. 4.

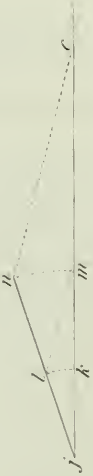


Fig. 5.

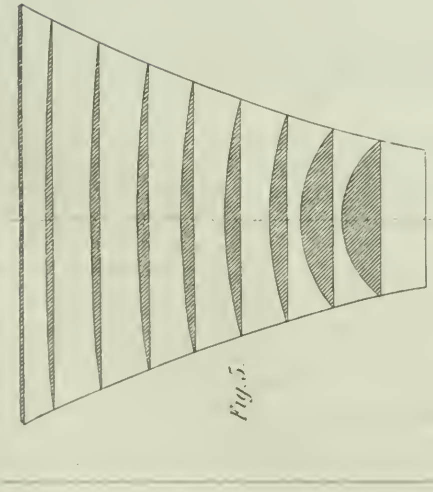
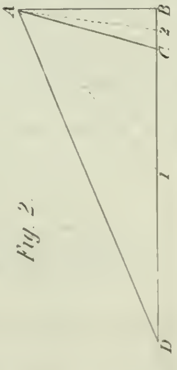


Fig. 2.



AMERICAN PATENTS.

List of American Patents which issued from January 13th, to February 3d, 1857, (inclusive,) with Exemplifications.

JANUARY 13.

44. For an *Improved Fire Arm;* Ethen Allen, Worcester, Massachusetts.

Claim.—" 1st, Placing the valve in the chamber, at the base of the nipple. 2d, Supporting and retaining the chamber by the parts. 3d, Operating the rammer by means of the lever, said lever forming a guard for the trigger."

45. For an *Improvement in Cotton Seed Planters;* Wm. Badger, Memphis, Tenn.

Claim.—" In combination with one or more sets of feeding arms, centrally located in the hopper, the false sides in the hopper for drawing or forcing the cotton seeds up to said feeding arms."

46. For an *Improved Field Fence;* Seneca H. Bennett, Belleville, Pennsylvania.

Claim.—" The combination of posts, secured firmly in their places by the top rails of the fence being let into the mortises in the top of the posts."

47. For an *Improvement in Looms for Weaving Pile Fabrics Double;* Erastus B. Bigelow, Boston, Massachusetts.

Claim.—" The employment in power looms for weaving two fabrics at one operation of transverse intersecting pile wires, when said transverse intersecting pile wires are woven in between the two fabrics. Also, the application or employment in power looms for weaving two fabrics at one operation, of a double positive shuttle motion, in combination with transverse, intersecting pile wires, for keeping the two fabrics apart. Also, the mode of arranging the parts which connect the shuttle or shuttles, with the loom shipper, whereby the loom is thrown out of gear, when the filling fails in either shuttle. Also, elevating and depressing the reed. Also, the mode of arranging the cams, whereby the combined action of the lathe, shuttles, intersecting pile wires, and ground warps, is effected; that is to say, placing the cams for operating the lathe on the shaft, and the cams for operating the shuttles on their respective counter shafts, all said cams moving at the same relative velocity, whilst the crank and cam for operating the pile wires, and the cams or tappets for operating the ground warps, are placed on the said counter shaft, but move at different relative velocities; the said crank and the said cam being affixed to the said counter shaft, whilst the said shuttle cam, and the said ground warp cams, or tappets, turn loosely thereon. And, finally, the mode of arranging the double let-off motion, in connexion with one positive take-up motion, whereby the delivery of the ground warp of each fabric is regulated by its respective tension, and held at the beat of the lathe."

48. For an *Improvement in the Manufacture of Hoes;* Samuel Boyd, City of N. Y.

" My invention consists of a new article of manufacture, viz: a hoe, having a steel blade, and a malleable cast iron eye, welded together."

Claim.—" A hoe, having a sheet steel blade, and a malleable cast iron eye, welded together."

49. For an *Improvement in Dies;* Robert Brayton, Buffalo, New York.

Claim.—" The use of chilled cast iron die, or dies."

50. For an *Improvement in Pumps;* James S. Burnham, Yorkville, New York.

Claim.—" Combining the air chamber directly with the diaphragm, so that the air chamber rides upon the diaphragm."

51. For an *Improved Implement for Holding Blacking Boxes;* William and Jasper Cairns, Jersey City, New Jersey.

Claim.—" The combination with a slotted handle of the stops and the adjustable jaw."

52. For an *Improvement in Knitting Machines;* Enoch Colvin, Poultney, Vt.

Claim.—"1st, The use of two circles of needles, for knitting a ribbed fabric. 2d, The method of moving the feeders by means of grooved eccentrics, with curves in the grooves."

53. For an *Arrangement of Fixed Rails as a Substitute for Railroad Switches;* Jos. T. Davenport, Augusta, Georgia.

Claim.—"The arrangement and form of the rails and guards to produce the connexion between the sidelings and the main track on railroads."

54. For an *Improved Mode of Rifling Ordnance;* Horace E. Dimick, St. Louis, Mo.

"The nature of my invention consists in cutting the grooves straight from the base of the bore, to about the distance of the trunnions, where the required twist shall begin; and in combination with this manner of grooving, giving the gun what is termed a freed bore of from one-one hundredth to one-tenth of an inch, depending on the calibre freeing the grooves, to double the extent of the bore."

Claim.—"A system of straight grooves, extending from the base of the bore to about the position of the trunnions, and twisting from thence to the muzzle, in combination with a freed bore, as an improved mode of applying the rifle principle to ordnance."

55. For an *Improved Automatic Regulator for Wind Wheels;* Joseph Dunkley, Carrollton, Maryland.

"The nature of my invention consists in the construction of an automatic governor."

Claim.—"The employment of the slide wing."

56. For an *Improvement in Burning Fluid Lamps;* M. B. Dyott, Philadelphia, Pa.

Claim.—"Removing the metallic connexion between the main and auxiliary burner of a fluid lamp, so far from the flame, or heat, interposing a non or bad conducting material between the burner and lighter, as that the heat of the main burner shall not be transmitted to the auxiliary, whilst the efficiency of the latter is in no wise impaired."

57. For an *Improvement in Stair Cases;* Augustus Eliaers, Boston, Massachusetts.

Claim.—"The improvement in the construction of stair cases, the same consisting in forming separate and independent 'string pieces,' between which the treads are held and griped—the whole being secured by a screw bolt, that forms a part of, or is attached to, the baluster."

58. For an *Improvement in Platform Scales;* Thaddeus Fairbanks, St. Johnsbury, Vermont.

Claim.—"My improved arrangement and combination of four bearing multiplying levers, a multiplying lever, and a lever, made so as to act at the same time, as an equalizing and multiplying lever. Also, arranging the suspension bridge, so that its arched standards shall extend upwards by the sides of the platform, and between it and the sides of the pit, in combination with arranging the transverse levers and their bearings below the platform, the same affording the necessary room for the vertical play of the longitudinal levers, while it secures an advantage as regards the depth of the pit."

59. For an *Improvement in Sewing Machines;* Milton Finkle, City of New York.

Claim.—"The construction and use of the loop former, for the purpose of parting the thread from the needle, so that the shuttle will be certain to enter."

60. For an *Improvement in Flour Bolt as applied to Grinding Mill;* Sanford E. Fitch and Theodore Sharp, Greenbush, New York.

Claim.—"The employment of the shaft and bolter, constructed and arranged so as to take the meal from the mill, and bolt it in successive and graduated portions, so as to prevent the finer portions of the meal from continuing unnecessarily in the mill, whilst the coarse particles return to the cylinder to be re-ground, or in certain cases, the substitution of a shelf in place of the bolter."

61. For an *Improvement in Locomotive Lamps;* Lewis A. Hamblen, Chicago, Ill.

Claim.—"Making a locomotive lamp, with three or more distinct chambers, said chambers all being arranged on the same level, and connected by two tubes, which run parallel, but not in line with one another, and provided with two elevated vent passages, which communicate with the ordinary vent passages."

62. For an *Improvement in Brick Machines;* Jacob Hockman, Mexico, Indiana.

Claim.—"The under frame or carriage, and trucks or rollers, in combination with the main supporting wheels and rotating cylinder of moulds."

63. For an *Improved Device by which Persons approaching may open Gates;* Royal E. House, Binghampton, New York.

Claim.—"The process for opening and closing road gates while riding on horse-back, or in a vehicle, through the gate passage; also, the apparatus."

64. For an *Improvement in Sewing Machines;* A. F. Johnson, Boston, Mass.

Claim.—"Combining the hook when furnished with a lever or arm, with the eccentric band, screw, and the adjustable projection or screw, for the double purpose of taking, first, the loop properly from the needle, and, secondly, for actuating the hook at the proper time for the needle to take the loop from the hook."

65. For an *Improvement in Hay Forks;* William Jones, Speedsville, New York.

Claim.—"The slotted socket, for the reception of the tangs of the tines, when used in connexion with the wedges, screw, and ferrule."

66. For an *Improvement in Presses;* Rhodolphus Kinsley, Springfield, Mass.

Claim.—"The compound action of the cam and eccentric, or their equivalents."

67. For an *Improvement in Balance for Detecting Counterfeit Coin;* H. Maranville, Clinton, Ohio.

Claim.—"The graduated disk and slide, connected and hung in the ears or lugs—the disk having ledges or guides attached to its face."

68. For an *Improvement in Oil Press;* Wm. W. Marsh, Jacksonville, Illinois.

Claim.—"Providing the lower or piston surfaces of the trusses, with vertical flanches and side pieces, when a space is left between said side pieces and the bottom piston surfaces."

69. For an *Improvement in Hand Looms;* Stephen C. Mendenhall, Richmond, Ind.

Claim.—"1st, The universal treadle cam, cam, shaft, spring, and hinge, in combination with the revolving cam, wheel, connecting rod, brace, hook, pin, and spring. 2d, The cords and pulleys, in combination with the spring, arms, triggers, and cords, for the purpose of throwing the shuttle back and forth through the loom."

70. For an *Improvement in the Cutting Apparatus of Harvesting Machines;* Robert J. Morrison, Richmond, Virginia.

Claim.—"The peculiar form of the lid, which overlies the cutters, viz: a lozenge or spear shaped point, and rhomboidal base, for the purpose of giving an oblique direction to the joints between said lids, to prevent the grass gum, or other material, from clogging said joint, and checking the efficiency of the lids."

71. For an *Improvement in Cotton Gins;* James F. Orr, Orrville, Alabama.

Claim.—"The combination of the two short ribs, the latter arranged in relation to the saw cylinder."

72. For an *Improved Machine for Rolling Tapering Tubes;* Wm. Ostrander, City of New York.

Claim.—"The combination with a tapering mandrel of cylindrical rollers, formed of disks or sections, for the purpose of rolling a tapering tube."

73. For an *Improvement in Nipple Shields;* James Parker, Boston, Massachusetts.

Claim.—"My improved nipple shield, constructed with a tubular cap, viz: one which shall only encompass the nipple on its sides, and not cover the front or end thereof, the whole front of the nipple guard being open."

74. For an *Improvement in Excavators;* Wm. Provines, Columbia, Missouri.

Claim.—"In combination with the scoops that cast their contents from them, the trigger and spring, for the purpose of regulating the point at which the scoops shall divest themselves of their load, so as to raise it higher, or cast it farther from the trench that is being cut."

75. For an *Improvement in the Construction of Burning Fluid Lamps;* David F. Randall, Chicopee, Massachusetts.

Claim.—"So applying to the gas burner, a tapering spur, that it may extend down into the body of the wick, and serve to conduct heat into the interior of the wick, while the external sides of the wick are heated by the burner and wick tube; and when such spur is used, I claim making it with one or more branches at top."

76. For an *Improved Tubular Auger;* J. A. Reynolds, Elmira, New York.

Claim.—"The employment of an auger, whose shank or stem shall form a screw, when combined with a guiding tube surrounding the screw shank of the auger, but not covering the head thereof. Also, the use of the guide tube, when combined with the sliding carriage—said carriage constructed with the slide."

77. For an *Improved Method of Hanging Farm Gates;* Isaac S. Roland, West Earl, Pennsylvania.

Claim.—"Constructing the upper hinge of said gate of the peculiarly shaped hinge arm, the pawl, and the cam, when the said parts are combined and operated with each other, in connexion with the loose play of the bracket pivots in the eyes of the upper and lower hinge arms."

78. For an *Improvement in Cotton Cultivators;* Joseph Shaw, Richland, Georgia.

Claim.—"In combination with the hoes, having both a vertical and lateral adjustment, the shoes above them, and so adjustable on or with said hoes, as to serve to throw the earth towards or from the plants, as may be required."

79. For an *Improved Hub Borer;* John Shaerer, Reading, Pennsylvania.

Claim.—"The vertically movable nut, in combination with the cutter shaft."

80. For an *Improved Machine for Planing Shingles or Tapering Pieces;* Reuben W. Sharp, Montgomery, Alabama.

Claim.—"The combination of the reciprocating slide and vibrating and rotating cutter head, with or without the stationary cutter head."

81. For an *Improved Mode of Constructing Mail Axles and Hubs;* Alfred E. Smith, Bronxville, New York.

Claim.—"The method of constructing a mail axle; that is to say, making the end of the box abut against the inner side of the collar, instead of against the holding plate, whereby the wear of the washer between the collar and the holding plate, may be compensated for by setting up the bolts."

82. For an *Improvement in Looms;* Daniel W. Snell and Stephen S. Bartlett, Woonsocket, Rhode Island.

Claim.—"1st, employing the positive take-up mechanism or cloth roll, as the point through which the variable strain and wind of warps is made to act more sensitively than from or by the variable vibratory reacting motion of the whip rolls, or sudden jerking of the beam or movable reeds. 2d, Effecting and producing a regular delivery and uniform strain of the warps by the equalizing strain lever—said strain lever being acted upon by the variable strain of the warps, through the positive take-up mechanism or cloth roll. 3d, The equalizing strain lever, acting in combination with the take-up mechanism and cloth roll. 4th, The equalizing strain lever, when operating in connexion with the positive take-up mechanism, in combination with any mechanism for producing rotary motion to the beam, and with any device or means for regulating the delivery and strain of the warps, as the beam decreases in diameter, and as the desired strain requires. 5th, Employing the rod with the pin, or equivalent, to act upon the strain lever as a means of moving the weight when the balance spring, or equivalent device, is not sufficient to move it. 6th, In combination with the pulley and pinion, the movable weight, the fixed yielding sectional friction piece, and friction lever. 7th, In combination with the weight and friction lever, the rack, or its equivalent, so as to act upon weight through catches, or analogous devices, as to gradually move the weight towards the fulcrum of lever, as the beam decreases in diameter, and as the desired strain of warp requires. 8th, In combination with the weight and friction lever, the jointed or stationary sectional friction piece and set screw."

83. For an *Improved Bore or Support for Posts of Field Fences;* Obed Spencer, Jacksonburg, Ohio.

Claim.—"The chair or base formed of the pieces, and ties or buttons, in combination with the posts."

84. For an *Improved Machine for Sawing Hoops;* Emerson C. Strange, Taunton, Massachusetts.

Claim.—" 1st, Making the saw of the peculiar form, being a plain circular saw, with a beveling or angular edge or rim, not confining myself to any particular angle which this rim makes with the saw plate, but using that which is best adapted to the work. 2d, The cam, the sliding journal box, the lever, and its connexions, the shield and the lever, and its attachment, so as to operate together."

85. For an *Improved Mode of Tightening Felloes in Wheels;* Augustus Stoner, Mount Joy, Pennsylvania.

Claim.—" The construction and operation of the metallic checks. Also, the manner of securing them in their place when applied to the felloes of wheels, by the use of melted metal of any kind, filling the grooves to keep them secure in their place."

86. For an *Improvement in Seed Planters;* Joseph Thompson, Durhamville, N. Y.

Claim.—" The spring plate, or its equivalent, so constructed and arranged as to hold the earth down firmly while the punches and tube are drawn out of the earth."

87. For an *Improvement in Corn Planters;* John S. Toan, Venice, New York.

Claim.—" The combination and arrangement for operation together, of the lower sliding tube, having a plough bit in front, and covering roller rigidly attached to it in the rear, with the secondary cross sliding valve and its operative, arranged to form part of said sliding tube—the whole being supported by the covering roller and plough bit, for the more perfect and easy operation of the secondary valve and sliding tube."

88. For an *Improvement in Locks of Fire Arms;* Alfred Tonks, Boston, Mass.

Claim.—" The arrangement or application of the spring rocker catch, the tooth of the trigger, and the shoulder, with respect to the striker, its arbor and the trigger, and so as to enable the striker to be operated."

89. For an *Improved Method of Adjusting the Size of the Mouth in Planes;* Thomas J. Tolman, South Scituate, Massachusetts.

Claim.—" The application to the common plane, of the screw attachment and key through the same, thereby regulating the mouth, and greatly increasing its value."

90. For an *Improvement in Reaping and Mowing Machines;* David Watson, Newark, New Jersey.

Claim.—" The use and application of the adjustable curved flat spring to the upper surface of the finger bar, when both are attached to the stirrup for joint action."

91. For an *Improved Screw-Feeding Gear;* Caleb C. Walworth, Boston, Mass.

Claim.—"The combination of a feeding screw or nut, arranged so as to have an endwise movement with springs, for the purpose of insuring the engagement of the screw and nut, and returning either of them to a mean position, when released from strain."

92. For an *Improvement in Power Looms;* Wm. Weild, Manchester, England; patented in England, March 7, 1855.

Claim.—" When applied to looms, or machinery for weaving pile fabrics, &c., the arrangement of the wires in grooves or flutes, formed in a roller or cylinder, the wires on being pushed into the 'shed' never wholly leaving the grooves in the roller or cylinder. Also, as a peculiarity and novelty, the arrangement of the wires, so that the one to be inserted in the shed is opposite, or nearly opposite, and in a line with the fell of the fabric, or that point where the reed will leave the wire on beating up such wires, having to be bent out of the straight line to present the points towards the widest part of the shed."

93. For an *Improved Method of Hanging and Operating Reciprocating Saws;* Carlyle Whipple, Lewiston, Maine.

Claim.—" The lever, two or more, when the upper lever or levers are attached to an adjustable shaft, and the levers, driven by a crank pin, having the rollers fitted upon it, and working within a slot in the lower lever, the saw being attached to the end of the levers."

94. For an *Improvement in Machines for Paring and Slicing Apples;* D. H. Whittemore, Chicopee Falls, Massachusetts.

Claim.—" So arranging the slicing knife, that it shall cut the apple into a continuous spiral slice. Also, so combining the parer and slicer with each other, that the operation of the two shall be simultaneous."

95. For an *Improvement in Calendar Clocks;* M. J. Whitmore, Potsdam, Assignor to self and Frank G. Johnson, Brooklyn, New York.

Claim.—"The placing of the intermittent cogs upon the upper and lower faces of the calendar wheel, and the giving of said cogs the necessary movements for accomplishing the intended purpose, by means of the sliding, and stationary, and intermitting pinions on the shaft."

96. For an *Improved Method of Fastening the Rails of Iron Fences in the Posts;* John B. Wickersham, City of New York.

Claim.—"Connecting the bars, strips, or rails, that pass through mortises in corrugated metallic posts or bars, to secure said posts at the points of intersection."

97. For an *Improvement in Artificial Legs;* O. D. Wilcox, Easton, Pennsylvania.

"The nature of this invention consists in the peculiar introduction of elastic cords or muscles, with their conjoined tendons extending from the sound part of the limb, by which the motion of the leg and foot may be effected and controlled."

Claim.—"The artificial elastic muscles, with their conjoined tendons running from the thigh to the foot, to effect and to control the motions of the leg and foot, in case of amputation at the knee, and below it."

98. For an *Improved Method of Hanging, Guiding, and Adjusting "Muley Saws;"* A. Winter, Pickens, South Carolina.

Claim.—"1st, The arrangement of the clamp guide posts, in combination with the sliding head, for securing it in any desired position. 2d, The method of constructing the sliding guide head, with the face guards keyed on to starts framed into the sliding head, for the purpose of adjusting or removing them in case of wear. 3d, The arrangement of the boxes in connexion with the cross-head, for the purpose of adjusting the saw to give it the desired advance motion during its downward stroke. 4th, The arrangement of the guide posts and upright, in combination with the beam and sill, whereby the usual fender posts, &c., are dispensed with."

99. For an *Improvement in Oil Pressing Machinery;* Wm. Wilber, New Orleans, La.; patented in England, June 12, 1856.

Claim.—"Extracting or expressing the oil from tempered oleagenous seeds, or other vegetable matter, by pinching and carrying said tempered material between two belts or aprons, made of hair cloth, or similar heavy porous materials, and thus forcing it through between compressing rollers; and this I claim, whether the oil be cold pressed or hot pressed, or both, or whether used in connexion with a reducing apparatus or separate therefrom."

100. For an *Improvement in Stove Thimbles or Deck Irons;* Loftis Wood, City of New York.

Claim.—"The deck iron, irrespective of the mode or process of casting."

101. For an *Improved Method of Mounting and Guiding Circular Saws;* G. F. S. Wright, Black Oak, South Carolina.

Claim.—"The employment or use of the spring applied to the machine, in connexion with the shoulder on the saw arbor. Further, the guide arranged or connected with the saw and rotating wedge, when used in connexion with the spring."

102. For an *Improved Mode of Lathing and Plastering;* John G. Vaughan, Middleborough, Massachusetts, Assignor (by mediate transfer,) to Isaac M. Singer, City of New York.

Claim.—"Plastering ceilings, or other surfaces, on lathing formed and secured, so as to leave intestices between them, with parallel sides oblique to the surface of the plastering when put on."

103. For an *Improvement in Machines for Forming Hat Bodies;* Ira Gill, Walpole, Assignor to self and Elbridge Brown, Malden, Massachusetts.

Claim.—"The forming of a hat body within an inclosed chamber, in which a vortex is produced—said chamber diminishing in area from its open to its closed end, to regulate the draft through it, and to avoid counter currents, eddies, or dead space. Also, in combination with the cone on which the hat body is formed, a register or draft regulator within it, so as to regulate the quantity of fur, or other material, that is to be gathered upon its upper and lower portions."

104 For an *Improved Method of Planing Sashes;* Daniel Berlew, Delaware, Ohio.

Claim.—"The combination with the reciprocating carriage and frame, the hooked and slotted springs, or their equivalents."

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105. For an *Improvement in Guides for Sewing Machines;* Wm. B. Bishop, Brooklyn, New York.

Claim.—"An elongated pressure bar or foot, having therein a flat groove to receive the edge of the centre or button hole plait of shirt bosoms; and also, a straight bearing surface, forming the under and guiding surface for the other seams or plaits of shirt bosoms, whereby I am enabled to stitch continuous straight seams in shirt bosoms, at a rapid speed, and perfectly straight, without any care or help from the operator."

106. For an *Improvement in Machinery for making Paper;* John S. Blake, Claremont, New Hampshire.

Claim.—"1st, The employment or use of the pump, vacuum chamber, and vacuum chest, provided with two compartments, and communicating with the pipes by means of the cocks. 2d, The air and water trunk, or reservoir, provided with the pipe, and communicating with the external pipe—the reservoir communicating by means of a pipe, with the pipes having the tubes connected to them—the whole being arranged for the purpose of trimming the edges of the paper or pulp; and I further claim, trimming the edges of the pulp, by means either of air or steam, when ejected through tubes. 3d, The pipe with the tubes attached and arranged for the purpose of discharging the margin or strips of pulp from the main wire cloth apron. 4th, The curved rod, with the rollers placed on it, the roller being connected with the springs, whereby the felt apron is stretched or distended transversely, and also guided or properly retained in position as it operates. 5th, The cylinder, in combination with the wet press cylinders, when the speed of the cylinder and cylinders is made variable, for the purpose of stretching or distending the apron longitudinally."

107. For an *Improvement in Machines for forming Bats for Felting;* John H. Bloodgood, City of New York.

Claim.—"The combination of the rollers with the vibrating drum. Also, the combination of the rollers with the vibrating drum and the roller."

108. For an *Improved Centre-Vent Water Wheel;* E. G. Cushing, Dryden, New York.

Claim.—"1st, Making the bucket with a back of such a curve that it forms a space of regular contraction from the outside to the inside of the wheel. 2d, Hanging the buckets, combined with a spring, in such a manner that the discharge orifice is regulated by the quantity of water let into the scroll, and the amount of power required, and closing together when the gate is shut."

109. For an *Improvement in Artificial Teeth;* Alfred A. Blandy, Baltimore, Md.

Claim.—"Constructing artificial teeth, with a hole passing vertically through them, for the reception of the molten metal, and with a neck and projecting sides."

110. For an *Improvement in Sewing Machines;* James E. A. Gibbs, Mill Point, Va.

Claim.—"Making the chain stitch with a vibrating needle, in combination with a stationary hook."

111. For an *Improvement in Sawing Machines;* George Gregg, Lowe's Mill, Va.

Claim.—"The whole."

112. For an *Improvement in Sewing Machines;* Elias Howe, Jr., Brooklyn, N. York; patented in England, July 26, 1848.

Claim.—"Drawing the thread through the cloth by means of a finger, or its equivalent, acting in connexion with mechanism which passes the needle through the cloth."

113. For an *Improvement in Steam Pressure Gauges;* E. G. Allen, Assignor to Henry O. Allen, Boston, Massacuhsetts.

Claim —" The helical dome."

114. For an *Improvement in the Manufacture of Double Pile Carpets and Rugs;* John Goulding, Worcester, Massachusetts.

Claim.—" The fabric made or woven ; that is to say, by crossing the top ground warp once only, for two shoots of binding filling, one of which passes through and binds the pile warps, and crossing the ground warp of the bottom fabric, once only for four shoots of the binding filling, three of which pass through and bind the pile warp."

115. For an *Improvement in Treating Photographic Pictures;* John Bishop Hall, City of New York.

Claim.—" Producing in pictures to be seen by direct light, a high artistic and stereoscopic effect, by combining with a white light, or reflecting back ground, or its equivalent, two or more identical pictures of the same subject, rendered more or less transparent, and executed on, or attached to, plates of glass."

116. For an *Improvement in Grain Separators;* George Heberling, Quincy, Ill.

Claim.—" The arrangement in a grain cleaning machine of the plate armed with teeth, and rubbers, the conical cylinder with beaters and fans attached, chute or rim, plate, tubes, and fan."

117. For an *Improved Die for making Spikes;* E. T. Henry, Scranton, Penna.

" This invention consists in forming a lip or cutting edge at the point end of the die."

Claim.—" The lip, formed at the point end of the groove in the die."

118. For an *Improvement in Harvesters;* M. G. Hubbard, Penn Yan, New York.

Claim.—" The combined cutting standard and inclined track clearer. Also, hinging the cutting standard and track clearer forward of the finger bar, and near the front end of the shoe, and supporting the same against lateral pressure, by means of the fulcrum post."

119. For an *Improvement in Cutters for Harvesters;* M. G. Hubbard, Penn Yan, New York.

Claim.—" The cutter, when formed in one piece."

120. For an *Improvement in Machines for Paring Apples;* Jared O. M. Ingersoll, Ithaca, New York.

Claim.—" The peculiar form of the rod, operated by pins on the face of the wheel, in connexion with the transverse bar."

121. For an *Improvement in Blast Furnace;* Wm. Kelly, Eddyville, Kentucky.

Claim.—"The combination of the hearth of a blast furnace, with the auxiliary tuyeres, for delivering a blast of air into the fluid iron in said hearth."

122. For an *Improvement in Harvesters;* Pells Manny, Waddams' Grove, Illinois.

Claim.—" Connecting the leading board to the main frame, by means of the curved elastic shoe, rigidly attached at its front to the leading board, and at its back to the under side of the main frame by joints in rear of the finger bar, in front of the driving wheel, when said leading board serves to carry the fulcrum of the seat lever, by which the front of the main frame is raised and lowered. And further, the combination and arrangement for operation together, of the seat lever and foot lever or treadle."

123. For an *Improvement in Bridges;* D. C. McCullum, Oswego, New York.

Claim.—" So combining the arch brace with the arched cord or beam, the top horizontal surface of the abutment or pier, and the lower cord or tie, by means of the iron shoe and tension rods, as that the thrust of the arched cord shall be thrown down upon the abutment, and any deflection in the lower cord be counteracted by an upward force at each end of the tension rods. Also, the method of lengthening or shortening the braces of a bridge truss or girder, by which the truss may be elevated or depressed as required, by means of the yoke, the plate on the end of the brace, and the straining pieces with their nuts."

124. For an *Improvement in Winnowing Machines;* Joseph and James Montgomery, Baltimore, Maryland.

Claim.—"The application of an adjustable sieve above the auxiliary screen box, when arranged in combination therewith, in such a manner as to separate the large impurities before the grain is subject to the action of the blast, in order to render said auxiliary screen box more efficient in its action, and thereby allow it to be made as limited in extent as desirable."

125. For an *Improved Hydrant;* James G. Morgan, Brooklyn, New York.

"The nature of my invention consists in constructing non-freezing hydrants with a waste cistern, in combination with one or more air or gas chambers, in such a manner that by compressing a portion of the air chamber, the water in the cistern will be forced up and fill the discharge pipe, whereby I am enabled to construct non-freezing hydrants with the cock and all the machinery above the ground ; also, in the peculiar manner in which the air chamber is compressed and released, by turning the handle of the cock."

Claim.—"The combination of a cistern to receive and retain the waste water of a hydrant, with one or more air or gas chamber or chambers, arranged in such a manner that by compressing the air chamber, the air therein will be forced into the cistern, thereby forcing the water in the cistern into the discharge pipe, and by releasing the air chamber from such compression, the water in the discharge pipe will run into the cistern ; nor do I limit my claim to a flexible air chamber, as I consider a piston and cylinder a mechanical equivalent. Also, the peculiar method of compressing and releasing the flexible air chamber, in connexion with the opening and closing of the cock."

126. For an *Improvement in Brick Machines;* B. F. Nave, Roanoke, Indiana.

Claim.—"The peculiar manner of operating the sand gauge by means of bent levers, in combination with cross-bars and shields, when the above parts are constructed and arranged for joint operation."

127. For an *Improvement in Hose Coupling;* Lodner D. Phillips, Chicago, Illinois.

Claim.—"The combination of the sections of the hose coupling (having conical tubes on the exterior ends thereof), with the conical sleeves."

128. For an *Improvement in Reflectors for Vaults;* Emil R. Pichler, Boston, Mass.

"The nature of my invention relates to a reflector made of glass, and having double corrugations in it so made as to break up and soften the rays of light reflected by it, and shed a more pleasant and less glaring light into the vault, cellar, or other dark apartment."

Claim.—"The so arranging of the glass plates in a frame or frames, as to have the appearance and effect of double corrugations, when said plates are backed by any reflecting material."

129. For an *Improvement in Laying Tops for Cordage Machines;* Wm. Robinson, Assignor to self and Amenzo W. Beardsley, Warsaw, New York.

Claim.—"In laying tops, the use of a movable cone, or its equivalent, so constructed and arranged as to yield to the larger strand or strands, and be pressed by them against the smaller strand or strands ; whether said movable cone is pressed against the strands by a spring, screw, or otherwise."

130. For an *Improved Machine for Bending Timber;* James D. Sarven, Maury County, Tennessee.

Claim.—"The bending frame, or its equivalent Also, in combination therewith, the mechanism and arrangement, or other equivalent devices, for the purpose of operating the bending roller, or its equivalent. Also, in combination with the bending frame, or its equivalent, the mechanism and arrangement, or other equivalent devices, for the purpose of bending timber in regular or irregular forms or curves, if the same is used in combination with a revolving mould, or mould operating or arranged in any other manner."

131. For an *Improved Method of Feeding Lumber laterally in Sawing Machines;* Samuel R. Smith, Florence, Massachusetts.

Claim.—"The combination of mechanism by which the lateral adjustment of the log is effected ; such consisting of the spring, the stationary bearing roller, or its equivalent, the lever, the toggles, the slide bar, the catch mechanism, the pinion, and the rack or racks applied to the carriage. Also, making the carriage or head block movable, independently of the ways or frame on which it is supported, and combining with said carriage and its movable rack, a lever and pawl, or an equivalent device, whereby said carriage may be moved towards the saw by the hand of an attendant applied to the said lever."

132. For an *Improvement in Cooking Stoves;* John G. Treadwell, Albany, New York.

Claim.—"As my invention and improvement in stoves with elevated ovens, having an escape flue below the elevated oven, and none above it, the construction and arrangement of the damper, so that by turning it in one direction, it shall compel the flame and smoke to pass around the oven, and by turning it in another, may shut off the flame and smoke entirely from the oven."

133 For an *Improved Machine for Bending Sheet Metal;* John Wright, Assignor to the S. Stow Manufacturing Company, Plantsville, Connecticut.

"This invention consists in the employment of an anti-friction plate, for the purpose of giving accuracy in the bending of the metal."

Claim.—"The plate."

134 For *Roofing Cement;* R. H. Smith, Cincinnati, Ohio.

Claim.—"A cement formed by materials, whereby a cement may be made and applied to roofing and other purposes, without the aid of fire to render it fluid, as heretofore, and by which the offensive smell arising from the use of coal tar, &c., is neutralized."

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135. For an *Improvement in Steam and Pressure Gauges;* John Allcroft and Thomas Mighten, City of New York.

"This invention consists in a certain arrangement of two or more elastic metal disks, which are deflected by the pressure of the steam or other fluid to be gauged, and thereby caused to give motion to an index."

Claim.—"The arrangement in pressure gauges of two or more corrugated elastic metal disks, at a distance apart, with an interposed ring or rings between their edges, and one or more central bearings between their centres."

136. For an *Improvement in Radiators for Fire Place Grates and Franklin Stoves;* Wm. Bennett, City of New York.

Claim.—"A perforated metallic plate or radiator, filling the fire place with a flanch of indefinite depth, and resting upon the fuel directly, or upon the top bar of the grate and against the fire back, in such a manner that the whole shall come below the flue of the stove, or throat of the chimney in which it is used, leaving the passage for the cold air to the chimney flue, free and unobstructed."

137. For an *Improvement in Stone Grooving Machines;* George W. Bishop, Brooklyn, New York.

Claim.—"A series of vertical inclined chisels of different lengths, placed one behind the other, in combination with a revolving hammer or cam, whereby I am enabled to give a positive motion to all the chisels from a single hammer for each series of chisels."

138. For an *Improvement in Machines for Shearing Sheep;* R. P. Bradley, Cuyahoga Falls, Ohio.

Claim.—"Increasing the length of the zigzags of the slot in the lever, as they recede from its fulcrum, so as to give the opposite end of the lever, which carries the teeth or blades, a uniform and equal motion as the pin is traversed in the slot."

139. For an *Improvement in Machines for Trimming Hedges;* Samuel Bradbury, Griggsville, Illinois.

Claim.—"The arrangement of the adjustable cutters and vertical cutters."

140. For an *Improvement in Speeders;* James S. Brown, Pawtucket, Massachusetts.

Claim.—"The device for dropping the spindle, arranged and operated substantially for the purpose of enabling the operator to remove the full bobbins, and insert the empty ones in their place."

141. For an *Improvement in Sash Fastener;* John Broughton, Chicago, Illinois.

"The nature of my invention consists in introducing a spring between the rib of the bolt, and the overhanging front plate of the socket."

Claim.—"The employment of a spring on the inner surface of the curtain *h*, of the socket."

142. For an *Improved Method of Inserting the Buckets in Shafts of Direct Horizontal Water-Wheels;* Tenison Chesher, Middleburg, Ohio.

Claim.—"The sliding buckets, combined with the mortises."

143. For an *Improvement in Corpse Preservers;* Samuel Cobb, Cincinnati, Ohio.

Claim.—"Providing the lid of the coffin with sides or edges, when arranged with the pipes at each corner of the lid and made to extend down into the pipes in each corner of the coffin, all for the purpose of confining the ice to the top of the lid, and drawing the water therefrom collected by the melting of the ice."

144. For an *Improvement in Calash Carriage Tops;* George and David Cook, New Haven, Connecticut.

Claim.—"The combination of the independent joints with the method of inserting the flat part of the shank or slat iron into the slot in the bow, and securing it there, so that the leather may be stitched, and the bows and shanks afterwards inserted and secured."

145. For an *Improvement in Rotary Brick Machines;* George Crangle, Philadelphia, Pennsylvania.

Claim.—"The pressing roller or small cylinder, having the recesses fitted with the coupled moving pistons or slides, so that as the surplus clay on the face of the partition which is next above the mould then forming a brick, is pressed into the recess of the roller by the said partition, the opposite piston shall thereby be caused to discharge the previously taken up clay, which is in the recess at the opposite side of the pressing-roller, the said pressing-roller being constructed and operating in combination with the mould cylinder."

146. For an *Improvement in Machines for Hulling Rice;* Lewis F. Currier. Portland, Maine.

Claim.—"The improvement in the construction and application of the wheel or wheels, to the endless trough, whereby advantages in skinning rice are gained, as specified, such improvement consisting in the dished wheel."

147. For an *Improved Clamp for Soldering Spectacles;* George N. Cummings, Hartford, Connecticut.

Claim.—"The use of the supporting strips, springs, and brick."

148. For an *Improvement in Grain Separators;* Michael De Camp, South Bend, Indiana.

Claim.—"1st, The combination of the flue with the flues and chamber, constructed and arranged for the purpose of separating light grain, cheat, &c., from still lighter substances by dividing the current of air. 2d, The construction of the fan, by combining with a disk attached to a rotating shaft, leaves fixed upon each side of the disk."

149. For an *Improvement in Tailors' Measures;* Lyman Derby, City of N. York.

Claim.—"The arrangement of the graduated rules for giving the outlines of the back and front of a coat, when said back and front rules are suspended upon the jointed rule."

150. For an *Improved Apparatus for Blasting Rocks under Water;* James B. Eads, St. Louis, Missouri.

Claim.—"In combination with the column of water over the rock, or other material to be blasted, a mortar or weight of greater specific gravity than the water, to act as an auxiliary in holding the blast to the rock."

151. For an *Improvement in Feed Boxes of Bee Hives;* Jeresiah D. Egleston, Canaan, Connecticut.

Claim.—"The platter and wire springs, in combination with the feed box."

152. For an *Improvement in Fastenings for Hames;* Henry A. Fowler, East Guilford, New York.

Claim.—"The cam, so arranged and operated with the shaft and cap (by means of a coil spring), that the cap will always adjust itself."

153. For an *Improvement in Machines for Fallowing Land;* Richard J. Gatling, Indianapolis, Indiana.

Claim.—"A series of spades, having a combined vertical, reciprocation, and spiral twist, through the agency of a system of cams and levers."

154. For an *Improvement in Repeating Fire Arms;* Heinrich Genhart, Liege, Belgium.

Claim.—"The combination of the rotating breech, with radial chambers for containing a series of charges, in combination with the sliding barrel, the rear end of which is fitted to enter the forward end of each chamber, when brought in line."

155. For an *Improved Vaccinating Instrument;* James W. W. Gordon, Catonsville, Maryland.

Claim.—"The application of the cup-shaped perforated rod, to the ordinary spring lancet."

156. For an *Improved Spring Lancet;* James W. W. Gordon, Catonsville, Md.

Claim.—"The providing the ordinary spring lancet with a sliding shield, having a movement from side to side."

157. For a *Process for making Illuminating Gas;* Robert Grant, Brooklyn, N. Y.

Claim.—"Passing the products of the destructive distillation of coal, and other substances, yielding carburetted hydrogen (gas) through fused metals, fusible at a low temperature."

158. For an *Improvement in Cutting Sheet Metal;* Samuel Hall, City of New York.

Claim.—"Making the scores in the stock of the shears, for the edge of the sheet metal cut to pass into, within or below the line or plane of the face of each shear blade, or cutter, and incressing them (the scores,) in depth as they extend from the cutters."

159. For *Mounting of Artificial Teeth;* George E. Hayes, Buffalo, New York.

"My invention consists in a certain mode of applying the platina connexions by which the teeth are attached to the plate and retained in place, whereby I am enabled to represent all parts of the teeth and gums of the natural shape and proportion ; and also, to afford to the work when finished, greater power of resisting any strain in the mastication of food, or other ordinary uses of the teeth, than is afforded by any of the modes of applying the connexions generally used."

Claim.—"Providing the teeth severally with a groove in the base, for the purpose of receiving a wire frame, or its equivalent, with a wire or wires projecting from the base on each side of the said groove, for the purpose of serving as connexions with the plate and with the wire frame, thereby enabling the natural crown to be represented on both sides of the tooth, and dispensing with the ordinary backing. Also, the attachment of the teeth to a wire frame, when the said frame is employed in addition to a direct connexion with the plate and stayed to the plate by stays, to give additional stability and security to the teeth."

160. For an *Improved Machine for making Coiled Springs;* James Harrison, Jr., City of New York.

Claim.—"1st, The combination of a revolving mandrel, and two or more grooved rollers, arranged and operating together. 2d, The employment of an adjustable springing bed, or otherwise, in an equivalent manner, applying springs under, or at the back, of the roller carriage, for the purpose of enabling the rollers to accommodate their movements exactly to the longitudinal profile and varying diameter of the mandrel, and thus ensuring their proper operation."

161. For an *Improvement in Harvesters;* Moses G. Hubbard, Penn Yan, New York.

Claim.—"The mode of attaching the finger bar to the frame, by means of two flat springs, when the same are so constructed and arranged as to operate in relation to each other."

162. For an *Acoustic Article;* Edward G. Hyde, Irvington, New Jersey.

Claim.—"The vibrating diaphragm or artificial ear, applied to an acoustic instrument or ear trumpet."

163. For an *Improved Method of Constructing Fence Posts;* Frank G. Johnson, Brooklyn, New York.

Claim.—"The post, formed and constructed in combination with the keys and rails."

164. For an *Improvement in Raising Sunken Vessels;* John P. Jourda, City of New York.

Claim.—"The arrangement and combination of the floats, chains, and chair bill or stopper, and chain dividers."

165. For an *Improvement in Cotton Gins;* Edwin Keith, Bridgewater, Mass.

Claim.—"1st, Inclining the upper part of the grates, for the purpose of giving an endwise motion to the roll of unginned cotton in the hopper. 2d, The construction of a brush cylinder, with a chamber or aperture in the end or head of the same, into which a current of air is drawn through an opening in the side of the gin, at a little distance from the axis, and being deflected by the form and direction of the aperture or chamber, is finally discharged at the periphery of the brush, near the sides of the gin, thereby preventing any accumulation of cotton at the ends of the brush. Also, the peculiar construction of the brush cylinder head, whereby two separate currents of external air are received at the end of the open brush, one of which currents being received near the centre in a direction parallel with the axis, is allowed to diffuse itself throughout the interior of the brush, and thus augment its general centrifugal action; while the other current being diverted and finally discharged through openings more or less contracted near the ends of the brush, and at right angles with the axis, tends to prevent all accumulation of cotton at the ends of the brush. 3d, The setting the rows of bristles in the brush alternately at different angles with the radii of the brush. 4th, The improved method of confining the lags or wings into the heads of the cotton gin brush, by means of lips or flanches projecting from the brush head. 5th, The introduction of a slight current of air into the flue of the gin, through one or more openings in the mote board or bottom of the flue, for the purpose of facilitating the dropping of the motes or dirt in front of or through the mote board. 6th, The adjustable screw-rods, in combination with the sliding mote board, and extending outward to the front of the gin, near the ginner."

166. For an *Improvement in Keyed Harps;* Anthony Kuhn, Baltimore, Maryland.

Claim.—"1st, A sounding board and suspended bridge, in combination with a solid bridge arranged at a distance from, or beyond the sounding board, so that the strings, extend across an open space between the sounding board and solid bridge. 2d, Extending the strings one-half their length, or more, through an open space beyond the sounding board, so as to make the instrument produce sounds like a harp, instead of sounds similar to those of a piano. 3d, Arranging the hammers above the key-board, and making them strike the strings towards and opposite to the sounding board, near the suspended bridge, instead of near the solid bridge. 4th, Increasing the number of strings in an instrument having the properties of a harp, so as to make the flats and sharps, without the pedals used in the old harps, so as to dispense with the pedals for that purpose."

167. For an *Improvement in Compound Rail for Railroads;* Charles T. Liernur, Mobile, Alabama.

Claim.—"The combination of a two part compound rail for railroads, in which the head of the top rail and the lower flanch of the bottom rail are each left undivided; the head of the top rail not resting on the upper part of the vertical rib of the bottom rail, but supported alone by its own vertical rib, in such a manner that the upper part of the vertical of the bottom rail, can be used as a temporary rail during track laying, so that no deterioration resulting therefrom shall prevent the well fitting of both rails; and thus, also, giving to the top rail a support unaffected by the variations of dimensions occurring in the process of manufacture through the rapid wearing of the rollers, and the unequal heating of the iron."

168. For an *Improved Life-Boat;* Matthias Ludlum, Essex, New York.

Claim.—"I claim as a new article of manufacture, the life-boat."

169. For an *Improved Self-Regulating Wind-Mill;* John M. May, Janesville, Wis.

Claim.—"The arrangement of the devices which are connected with each other, for the purpose of regulating the velocity of the wind-wheel, and also for the purpose of controlling the wind-wheel, independently of its self-regulating properties."

170. For an *Improved Lathe Machine;* Joseph B. O'Key, Indianapolis, Indiana.

Claim.—"The arrangement of one or more series of cells, and their gauge stop, in the arcs of concentric circles, for the reception of the blanks, in combination with an oscillating knife or knives."

171. For an *Improvement in Cotton Presses;* M. L. Parry, Galveston, Texas.

Claim.—"The double geared nut, working in combination with a screw, and operated by one or more shifting pinions."

172. For an *Improved Ore Cleaner;* David Pollock, Lancaster, Pennsylvania.

Claim.—"The cylinder with adjustable bars, the perforated guard, the hollow perforated shaft, the perforated ledges, the arms and lifters, the adjustable traveling roller, for the purpose of crushing, washing, screening and cleaning ores, or other material, either wet or dry."

173. For an *Improved Writing Pen;* John F. Reeve, Richmond, Virginia.

Claim.—"1st, The so jointing together of the two pieces of rigid or non-elastic metal, or other material, that the same may form a pen, the required opening and closing of the point of which may be effected by the greater or less pressure of the said point on the paper, assisted by the springs and wedge, or equivalent device. 2d, The regulating spring, as applied to the cams."

174. For an *Improvement in Hernial Trusses;* Samuel S. Ritter, Philadelphia, Pa.

Claim.—"The combination of the springs, and, with the pad attachment."

175. For an *Improvement in Harrows;* Daniel W. Shares, Hamden, Connecticut.

Claim.—"The construction and arrangement of the series of teeth on the side bars, in relation to the said bars and to each other."

176. For an *Improvement in Axle Boxes;* Alfred E. Smith, Bronxville, New York.

Claim.—"Making metallic pipe boxes for carriage wheel hubs, with the two ends cylindrical or conical to fit the arm of the axle, when these two sections are connected and combined with the intermediate part, corrugated or fluted inside and outside, for the three-fold purpose of giving greater strength with a given weight of metal, to form a series of longitudinal oil cells all round the arm of the arch, and to form longitudinal ribs all around on the outside, to enter the wood when driven in, that it may be effectually held and bound in the hub."

177. For an *Improved Composing Stick for Printers;* Wm. T. Tillinghast, Dayton, Ohio.

Claim.—"The combination of the several devices, and their application in forming the composing stick."

178. For an *Improvement in Oil Cases;* Isaac Van Hagen, City of New York.

Claim.—"The double tube, the loose valve, and ventilator thumb-piece."

179. For an *Improvement in Core Boxes;* Abner Van Horn, City of New York.

Claim.—"The use of the compartments, when arranged in connexion with the lifts and flask."

180. For an *Improved Mode of Altering Flint Lock Fire Arms to Percussion;* James Noble Ward, U. S. Army.

Claim.—"Securing the cone seat upon the lock plate, and making the contact of said seat and the barrel."

181. For an *Improvement in Machinery for Stripping the Top Flats of Carding Engines;* George Wellman, Lowell, Massachusetts.

Claim.—"1st, The arrangement of the segmental gear with its rim, and the pinion with its notched plate, upon the vibrating arm or rocker frame. 2d, Constructing the segmental gear with its set rim, and the lifting and stripping cams, in one piece or casting. 3d, The double mangle pin, segment, or rim. 4th, The combination of the pinion and its notched plate, with the double mangle pin segment."

182. For an *Improvement in Machines for Forging Metal;* Elbridge Wheeler, Fettonville, Massachusetts.

Claim.—" 1st, The combination and arrangement of the rolls, one of them being capable of motion to and from the other, and entirely within the control of the operator. 2d, The stationary guard, adapted to grooves in both the upper and under rolls. 3d, Prolonging the boxes in which the rolls run, for the purpose of straightening the work."

183. For an *Improved Clamping Machine;* Elbridge Wheeler, Marlboro', Mass.

Claim.—" Constructing the movable jaw in two pieces, and hinging them in the centre."

184. For an *Improvement in Nut Machines;* S. H. Whitaker, Cincinnati, Ohio.

Claim.—" The circular shears and rollers or dies, for cutting off the blanks, and smoothing their edges, the bar being grasped or held by the mandrel and bar, or any proper device. Also, the circular shears and rollers or dies, in combination with the fixed mandrel, punch, or rod, and reciprocating bar."

185. For an *Improvement in Mills for Tempering Oleaginous Seeds;* Wm. Wilber, New Orleans, Louisiana.

Claim.—"The arrangement of machinery by which oleaginous seeds, as they are being tempered, shall be subjected to the direct and indirect action of steam in their transmission through the machine, from the grinding to where it is taken, preparatory to its being pressed."

186. For an *Improvement in Machines for Hulling and Separating Cotton Seeds;* Wm. Wilber, City of New York.

Claim.—" 1st, In combination with the runner and concave, a blast across the top of said runner, to carry the material to the spout or trunk, as soon as it rises to the top of the runner. 2d, In combination with the runner and concave, the trunk with its teeth or grooves, for facilitating the separation of the hulls and kernels. 3d, Hanging the sieve box by an eccentric to the end of the shaft of the runner, and by the plate to the frame, to give said sieve box its compound, vertical, horizontal, and end movement. 4th, The plate, with their dress arranged at the feeding-in point of the machine, and forming a portion of the breast of the machine."

187. For an *Improvement in Supporting Masts in the Decks of Vessels;* Thomas J. Woodworth, Salem, New Jersey.

Claim.—" Constructing the partner for the masts of vessels."

188. For an *Improvement in Seeding Machines;* Erastus D. Wooding, Dixon, Ill.

Claim.—" The spreading roller."

189. For an *Improved Door Spring;* A. F. Chatman, Assignor to self, and Jacob Pearce, City of New York.

Claim.—" A wire, doubled lengthwise on itself two or more times, so that it will form a spring by opposite forces, when enclosed in a cylinder or tube, and not otherwise, to be used as a hinge, in combination with the spring, or without the hinge."

190. For an *Improved Machine for Planing Hoops;* Sylvester Sawyer, Assignor to the American Hoop Machine Co., Fitchburg, Massachusetts.

" My present invention consists in certain improvements upon a machine for which Letters Patent were granted to myself, in connexion with Joseph Sawyer, for an improved hoop machine, on the 6th day of May, 1856."

Claim.—" 1st, Giving the frame which carries the roll a play between the adjusting screws, and bringing the roll up to its work by the spring. 2d, The eccentric lever, graduated arc and spring, for the purpose of regulating the thickness of the hoop, and of forming the lap. 3d, The combination of the cutters, as arranged upon the reciprocating gate, in combination with the rest."

191. For an *Improvement in Fountain Pens;* Joseph C. Silvy, Assignor to Thomas J. Dobyns, New Orleans, Louisiana.

Claim.—" The employment of a separate or independent spring to the guide or stopper rod, for operation with it and the pointed fountain case or handle."

192. For an *Improvement in Operating the Valve of Steam Hammers;* P. L. Weimer, Lebanon, and Samuel P. Francisco, Assignors to Samuel P. Francisco, Reading, Pennsylvania.

Claim.—"The so arranging of the crank and the expanding levers, or the axes or trunnions of the hammer stock, as that they can be separately adjusted thereon, but at the same time worked with the rocking or rolling of the hammer shaft, for the purpose of regulating at any time the power and motion of the hammer, by or through the movement of the slide valve."

193. For a *Vermin Destroyer;* Welcome Whitaker, Assignor to Henry L. Palmer and Julius A. S. Kilton, Troy, New York.

Claim.—"The use of bellows and flexible pipe."

194. For an *Improvement in Machines for Paring and Slicing Apples;* Clarissa A. Hubbard, Executrix of Guy H. Hubbard, dec'd., late of Shelburne Falls, Mass.

Claim.—"The arrangement of the machine with its paring and slicing knives, in such a manner as to careen upon the joint."

ADDITIONAL IMPROVEMENT.

1. For an *Improvement in Harvesting Machines;* Robert J. Morrison, Richmond, Indiana; patented December 16, 1856, additional, dated January 20, 1857.

Claim.—"Allowing the roller to come against an elastic or yielding stop, when the machine returns to its position, after passing any irregularity in the ground, for the purpose of saving the machine from sudden jars."

RE-ISSUES FOR JANUARY, 1857.

1. For an *Improvement in Axle Box Rollers;* George W. Geisendorff, Indianapolis, Indiana, and Jacob C. Geisendorff, Cincinnati, Ohio; patented Feb. 6, 1855; re-issued January 13, 1857.

Claim.—"Giving a position, motion, or rotation to the lubricating roller, by the axle of the car wheel."

2. For an *Improvement in Moulds for Pressing Bonnet Fronts;* Whitten E. Kidd, City of New York; patented Nov. 28, 1854; re-issued Jan. 13, 1857.

Claim.—"The hollow metallic mould of the form required to give the complete form required for bonnet fronts, and provided with a mode of imparting to it the required temperature, and the nature of corresponding form, to make pressure by a motion in or nearly in the line of the axis, when the said mould and matrix are used for controlling the position of the strip."

3. For an *Improvement in Cleaning the Top Flats of Carding Engines;* William H. Walton, City of New York; patented December 9, 1856; re-issued Jan. 13, 1857.

Claim.—"Suspending the top flats or lays upon pivots in the centre of the ends, by which they can be raised out of the way of the adjoining flats or lays, to be turned by means of a rack working on pinion upon their pivots. Also, stripping the flats or workers by a rotating brush, so arranged that a card may in turn, strip the brush and return the stripping to the main cylinder. Also, the combination and employment of the 'lickers in' c c' d d' and worker e, and acting as worker and strippers."

4. For an *Improvement in Machinery for making Cord;* William E. Nichols, East Haddam, Conn.; patented Dec. 11, 1849; re-issued Jan. 20, 1857.

Claim.—"1st, Twisting or controlling the twist of the strands, while the main frame is revolving to lay them into cord, by causing an even faced wheel attached concentrically to, and revolving with the bobbin frame to travel over a fixed and smooth surface-friction, causing the frame to revolve. 2d, Revolving the bobbin frames on their own axes, to twist the strands at the same time that they are carried round a common centre, to twist the cord by rolling them on the surface of a stationary annular inclined track, towards the inner or outer periphery of which they can be adjusted to run, so as to vary the relative twist of the strands and cord. But I make no claim to the mere turning of the bobbin frames by friction, by any of the devices usually employed for similar purposes. 3d, The construction and arrangement of the centre stem or spindle of the bobbin frame, whereby the yarns are collectively subjected to progressively increasing tension and twist from the commencement to the end of the process of laying them into the strand, whereby the latter is rendered smooth and regular in its figure and of uniform density and strength, and subjected to uniform tension while being laid into the cord."

5. For an *Improved Portable Steam Sawing Machine;* Samuel R. Wilmot, City of New York; patented Aug. 14, 1855; re-issued Jan. 27, 1857.

Claim.—" An independent portable steam sawing apparatus, and connected in such manner with the boiler for generating steam, that the steam sawing apparatus can be moved from tree to tree, or applied in different positions at different parts of the same tree, without moving the steam boiler, or breaking the steam connexion therewith."

DESIGNS FOR JANUARY, 1857.

1. For *Upright Stoves;* Abner J. Blanchard, South Reading, Mass.; dated January 6, 1857.

Claim.—" The design of the base or pedestal, the rings, door, and cap plate connected."

2. For *Ever-Pointed Pencil Cases;* John A. Knapp, City of New York; dated January 6, 1857.

Claim.—" Making the case in the form of a cannon provided with the beads."

3. For *Clock Case Boards;* Charles Chinnock, City of New York; dated January 6, 1857.

Claim.—" The configuration of the wreath and projecting scrolls."

4. For *Printing Types;* George Bruce, City of New York; dated January 6, 1857.

Claim.—" I call this new type double great primer copper-plate script."

5. For *Parlor Stove;* Samuel F. Pratt, Boston, Mass.; dated January 13, 1857.

Claim.—" The combination and arrangement of ornamental figures and forms."

6. For a *Cooking Stove;* N. S. Vedder, Assignor to Newberry, Filley & Co., Troy, N. York; dated January 13, 1857.

7. For *Cook Stoves;* N. S. Vedder, Assignor to Wolfe & Warren, Troy, New York; dated January 27, 1857.

8. For *Parlor Cook Stoves;* N. S. Vedder, Assignor to Wolfe & Warren, Troy, N. Y.; dated January 27, 1857.

Claim.—" The ornamental designs and configurations."

9. For *Railroad Car Stoves;* James L. Howard, Hartford, Connecticut; dated January 27, 1857.

Claim.—"The ornamental design and configuration of the top plate, of the bottom plate, and of the door."

FEBRUARY 3.

1. For an *Improved Attachment to Sewing Machines;* Elisha Alexander, City of New York.

Claim.—" Combining the mechanism of the guiding and conveying rollers with the mechanism operating a sewing machine, having an independent feed, in such a manner that the said rollers shall guide automatically the finished work away from the machine in a straight line, by revolving in opposite directions with a speed regulated by that of the machine."

2. For an *Improved Excavating and Dredging Machine;* Jonathan R. Anderson, Chicago, Illinois.

Claim.—" The so arranging of the dipper with a traveling carriage, as that they may be automatically moved in and out on the arms, for the purpose of ensuring the filling of the bucket where the material is to be excavated. Also, in combination with the lever, the sliding piece, the clutch bar, and pawl, with their several appliances, so that by a single lever the attendant has entire control of the machine."

3. For an *Improved Safety-Coupling for Railroad Cars;* Edward H. Anderson, Milford, Delaware.

Claim.—"The special mode of effecting the self-coupling and self-uncoupling, by the combined action of the following parts, to wit: catches bolt with its rounded end bolt, with its concave end, jointed arms, and spring catches or jaws."

4. For an *Improvement in Filing Saws;* A. M. Beardsley, Constantine, Michigan.

Claim.—"The two piles arranged as shown, and attached to the reciprocating bed plate, which works between guides on a movable or adjustable plate, the bed plate being operated by the lever, or its equivalent, and the plate by the lever."

5. For an *Improvement in Seed Planters;* Levi Beemer, Libertyville, N. J.

Claim.—"A combination of triangular seed boxes, located upon the sides of the drive wheel as specified, with the measuring keys operated by the cams to admit the seed into the depositing cups."

6. For an *Improvement in Couplings for Wagons;* Jacob Boyers, Grandville, Va.

Claim.—"In combination with the ordinary coupling pole of a wagon, the rod, bar, or pole, connected to the front axle, and passing through the bow or hounds and through the rear axle, for the purpose of causing the rear wheels to track after the front ones, and so that the two axles can be coupled shorter or longer, without in any way affecting the proper tracking of the wheels."

7. For an *Improvement in Lard Lamps;* J. S. Brown, Washington, D. C., Assignor to Joseph Kent, Baltimore, Maryland.

Claim.—"The bosse ring, in combination with the brush of wires."

8. For an *Improvement in Anvils;* Otis Brigham and Seth E. Brigham, Fitchburgh, Massachusetts.

Claim.—"Combining with the anvil the secondary movable grooved horn, and mechanism for confining the latter to the former."

9. For an *Improvement in Machines for Cleaning Cotton;* Francis A. Calvert, Lowell, and Charles G. Sargent, Westford, Mass.

Claim.—"1st, The above described arrangement of the cylinders, the guard, and the diaphragm, whereby the motes and dirt removed by the guard are thrown back upon the first cylinder. 2d, The grating beneath the brush, which takes the material from off the fine tooth cylinder when the brush is placed over the cylinder, whereby the fly is either again carded on to the cylinder, or is recovered upon the surface of the perforated cylinder, the dust all passing through this cylinder."

10. For an *Improvement in Window Blinds;* Alexander M. Cochran, City of N. Y.

Claim.—"1st. The fitting of the tenons in one side of the blind to oblique slotted mortises, and securing them all in place by a long rod or wire. 2d, Effecting the connexion between the slots and rods, by making the rods of metal tubing with slits providing ears, to enter the said slits and passing a wire through the tubular rods and the ears. 3d, The confining of the slats in a closed or open condition, by means of bail shaped bars, applied and operating as described, in combination with the notches in the backs of the rods."

11. For *Improved Adjustable Seats for Carriages;* George and David Cook, New Haven, Connecticut.

Claim.—"So constructing, attaching, and locating the seats, as to preserve the perfect symmetry of the carriage, whether it be used with one or two seats, without any necessity of securing the movable seat."

12. For an *Improved Machine for Cutting Veneers;* Peter Cook, Tonawanda, N. Y.

Claim.—"The swinging box or head formed of the plates, said box or head working over concave beds and cutters, when the above parts are arranged to allow the bolt to feed itself to the cutters by its own gravity."

13. For an *Improvement in Puddling Furnaces;* Jacob Green, Philadelphia, Penn.

"My invention relates to those furnaces used in the manufacture of malleable iron, technically termed puddling furnaces, and consists in constructing such furnaces with any convenient number of openings in each of the side walls, and placing a fire place at each end of the furnace, as fully described hereafter, the object of my improvement being the economizing of space, fuel, labor, and the production of a better quality of iron."

Claim.—"The constructing of puddling furnaces with any convenient number of openings or working holes on each side, and a fire place at each end, the bed of the furnace being common to both fires."

14. For an *Improvement in Machines for Sowing Seed Broadcast:* George Hall, Morgantown, Virginia.

Claim.—"The combination of the hinged and adjustable dash board with the working fingers and exit openings, for the purpose of taking the grain from the hopper and scattering it broadcast."

15. For an *Improvement in Machines for Forming Felt Hat Bats;* Washington G. Hagaman, Philadelphia, Pennsylvania.

Claim.—"The combination of the flat rotary sieve with the deflector."

16. For an *Improved Gas Generating Apparatus;* James Hansor, Wandsworth Road, England.

Claim.—"The pipes and the dampers as combined with the retorts, operating for the purpose of readily ascertaining and regulating the progress of the operation of gas making."

17. For an *Improvement in Machines for Dressing and Polishing Stone;* David Hinman, Berea, Ohio.

Claim.—"The combination of the disks attached to hollow revolving shafts with the supporting and vibrating rods."

18. For an *Improved Shingle Machine;* William Hucy, Columbia, Pennsylvania.

Claim.—"1st, The particular method of adjusting the knives within a cylindrical (or other shaped) case, that they may be made to rise and fall according to the thickness of the shingle or board. 2d, Attaching the sawing and planing machines in such juxtaposition as to operate automatically."

19. For an *Improved Fan Blower;* Chester P. Marshall, Worcester County, Mass.

Claim.—"The application of the fixed partitions in the conducting air tubes of fan blowers."

20. For an *Improvement in Boxes for Pise-work Walls;* Otis Needham and Wales Needham, New Haven, Connecticut.

Claim.—"1st, The construction of the box with the movable end plates fitting to grooves in the side plates, and with a roller at one end near the top, and another at the other end near the bottom, the one to run on the finished part of a course of work which is in progress, and the other on a finished course or on the foundation of the wall, to guide the box in a horizontal line, while the plates keep it from deviating laterally from a straight line. 2d, The plate applied and operating in combination with the other parts of the box, to produce window caps, mouldings, or projections."

21. For an *Improved Apparatus for Containing and Dispensing Syrup for Soda Fountains;* James R. Nichols, Haverhill, Mass.

Claim.—"The arrangement of a series of cans with their pipes and corks, whereby they may be simultaneously charged with compressed air by a single pump, and any one of them may be isolated from the others."

22. For an *Improved Cotton Seed Planter;* James F. Orr, Orrville, Alabama.

Claim.—"Combining an adjustable plate with the seed cylinder."

23. For an *Improvement in Corn Planters;* Samuel M. Perkins, Fort Hill, Illinois.

Claim.—"The seed chambers upon the shaft with radial depositing apparatus, in combination with the wheels and mechanism by which said wheels are adjusted relative to the shaft.

24. For an *Improved Machine for Grinding File Blanks;* Robert G. Fine, Newark, New Jersey.

Claim.— "1st, The reciprocating frame attached to the frame as shown, and having springs connected with it, when said frame is used in connexion with the grindstone and patterns. 2d, Attaching the frame to the levers, bars, and shafts having the roller upon it."

25. For *Improved Cultivators;* Norman W. Pomeroy, Meriden, Connecticut.

Claim.—" The method of working the valves by means of the spiral spring and elastic disk or bottom."

26. For an *Improvement in Sewing Machines;* Samuel F. Pratt, Roxbury, Mass.

Claim.—" The combination with the arm of the spring, the projections, the bent lever and its projection, or their equivalents, the same being to produce the motions of the feed bar. Also, moving the loop hook or looper diagonally up to and away from the needle. Also, effecting the movements of the hook at the proper times, that is to say, by means of the plate attached to the arm operating upon the arm of the looper."

27. For an *Improvement in Life Preservers;* Warran A. Simonds, Boston, Mass.

Claim.—" A life preserving float composed of separate and independent sectional chambers or air vessels, covered and surrounded upon all sides by exterior sectional floats filled with cork or solid buoyant material."

28. For an *Improvement in Ladies' Riding Saddles;* Robert Spencer, City of New York.

Claim.—" Placing the pommel or head back of the front edge of the bars and in a diagonal position, whereby I am enabled to depress it to give ease of position to the rider, without interfering with the horse's withers. Also, connecting the near or short horns with the tree, by a screw on the end fitted to a series of holes, so that its position relatively to the seat and pommel may be shifted at pleasure to suit the rider. Also, the arrangement of the stirrup leather, in combination with what is known as the Mexican bars, whereby I am enabled to make a secure ladies' saddle without the use of the points heretofore employed for embracing the sides of the horse."

29. For an *Improved Method for Joining Boxes, &c.;* James Stimpson, Baldwinsville, Massachusetts.

Claim.—" The joining of boxes, drawers, furniture, &c., by means of round tenons and mortises, and a half lap or secret joint."

30. For an *Improved Pump;* Ambrose Tower, City of New York.

Claim.—" The raised or projective seat, and ebb water way, when the water, &c., is discharged from the ebb water way below the surface of the top of the raised or projective seat; thereby allowing all foreign or heavy substances that flow over the seat to be instantly forced out; consequently, the valve at all times has free play, and cannot become choked."

31. For an *Improved Mode of Hanging Window Sashes;* William Webster, Morrisania, New York.

Claim.—" The constructing of window sash with holes on their inner face, in connexion with the holes and grooves."

32. For an *Improvement in Blast Furnace;* Henry Weissenborn, City of New York.

Claim.—" The mechanical arrangement of feeder, in combination with a surrounding gas chamber, with an open bottom placed above the furnace throat, whereby the gas is prevented from escaping from the throat of the feeder without being covered, and then forced into the gas chamber by the dense body of coal and ore always contained in the feeder, and therefore delivers a regular supply of gas which can be carried, descending to any heating furnaces placed on the bottom ground of the blast furnace, with the advantages as if applied on the top of it."

33. For an *Improvement in Brick Machines;* William Wood, Hartford, Connecticut.

Claim.—" Constructing the front of the press box with the front of the grate attached thereto, so that by means of slides and swing front, a portion or all of the front of both press box and grate can be raised."

34. For an *Improved Shingle Machine;* William A. Whiting, St. Louis, Missouri.

Claim.—"Giving an elastic bearing to its rest or to the boxes of the knife wheel, or to the equivalents thereof."

35. For an *Improved Stump Excavator;* Jason W. Wood, Washington Township, New Jersey.

Claim.—"The employmont of the cams, in combination with the levers and the chains."

36. For an *Improvement in Brass Kettle Machine;* Mary A. Cannon, administratrix of John Cannon, deceased, Warran, Rhode Island, Assignor to the New York and Brooklyn Brass Company, City of New York.

Claim.—"1st, Elongating the handle of the tool into the lever to be operated by hand, when the said tool is moved up to the work. 2d. The arrangement of the shaft, whereby it is made to serve for the driving of the sliding bed, and also as a pivot, upon which the slide which carries the said bed is adjusted, thereby enabling the adjustment of the bed to be effected without affecting the driving gear."

37. For an *Improvement in Sewing Machines;* Joshua Gray, Assignor to self and John Gault, Boston, Massachusetts.

Claim.—"The combination and arrangement of the plate and slide, with their slots and pins."

38. For an *Improvement in Washing Machines;* Amos Jacobs, deceased, late of Ithaca, New York.

Claim.—"The combination of an oblique beater or dasher with a tub, constructed in such a manner that the stroke of the dasher or beater causes the tub or vessel to revolve, for the purpose of washing, cleaning, stamping, and rinsing clothes."

39. For an *Improvement in Accelerating Fire Arms;* Azel S. Lyman, Assignor to the "Accelerating Fire Arms Company," City of New York.

Claim.—"The employment of the accelerators or additional charge chambers. Also, covering the muzzle and exhausting the air through an appropriate aperture, whereby the atmospheric resistance is removed from the front of the projectile while passing along the bore."

40. For an *Improved Joiner's Plane;* J. F. Palmer, Auburn, New York, Assignor to S. W. Palmer, Detroit, Michigan.

Claim.—"The two plates and plane iron, arranged relatively with each other, and used in connexion with the screw rod and rod."

41. For an *Improvement in Operating Cut-off Valves of Steam Engines;* George H. Reynolds, Medford, Massachusetts, Assignor to self and D. B. Hinckley, Bangor, Maine.

Claim.—"Operating the cut-off valves in connexion with an ordinary slide valve, by the inclined sliding dogs, or their equivalents."

42. For an *Improvement in Pistols;* Wm. S. Butler, Assignor to Butler, Snyder & Co., Rocky Hill, Connecticut.

Claim.—"Constructing the pistol by casting the barrel, the frame or main part of the stock and guard, all in one piece."

43. For an *Improved Bridge;* Thomas W. H. Mosely, Covington, Kentucky.

Claim.—"1st, The compound arch. 2d, The saddle pieces, in combination with the stirrups and said compound arch. 3d, The sliding suspension plate, in combination with the cord and radial suspension rods."

44. For an *Improvement in Fastenings for Harness Hames;* Homer Compton, Wells Corner, Pennsylvania.

Claim.—"The combination with a hame of a spring bolt, a catch plate, and a spring plate."

45. For an *Improvement in Smiths' Forge;* John W. Crammel, Olivet, Michigan.

Claim.—"The use of two hollow sectional nozzle pieces, moving at right angles in a two-way groove formed by the chamfered ribs, in combination with the two-wayed slotted opening in the hearth plate, formed and bounded by the stationary rims, and the chamfered corner block, whereby the moving nozzles can slide past each other, and form a continuous joint in any position."

46. For an *Improved Tool for Tenoning Spokes;* John J. Croy, Caledonia, Missouri.

Claim.—" 1st, The employment of a tube for holding the spoke, while the tenon is being cut. 2d, The combination of an adjustable end piece or bed with the tube. 3d, The employment of an adjustable clamp cutter head."

47. For an *Improvement in Shirt Bosom Studs;* John P. Derby, Cavendish, Vt.

Claim.—" The side pieces, passing the one above and the other beneath the cross-piece, forming a double coil and double lock."

48. For an *Improved Machine for Cutting Tenons on Blind Slats;* Seth C. Ellis, Albany, New York.

Claim.—"The arrangement of the rotating disks, with their slots disposed in reference to, and in combination with, the saws, for the purpose of regulating the revolution of the slat, so as to direct the saws in cutting perfectly cylindrical axes or tenons to it. Also, the feeding apparatus, to wit: the sliding box, disks with the wheels lying within the jaws, and the lever with the eccentric, acting together, and in combination with the disks and saws."

49. For an *Improved Self-operating Device for Tilting Buckets in Raising Water from Wells;* Daniel P. Farnham, Milton, Wisconsin.

Claim.—"The fastening formed of the rods attached to the cross-pieces of the links, and the loops on the buckets, in combination with the pendent or swinging-rod, placed within the framing or curb."

50. For an *Improved Hydrant;* Wm. Fields and Solomon Gerhard, Wilmington, Del.

Claim.—" 1st, The combination of the lever with the rods operating the plungers. 2d, The plunger valve, when arranged in relation to the bent pipe, and when operated in connexion with the plunger, and not otherwise."

51. For an *Improvement in Forging Gun-lock Springs;* George P. Foster, Bristol, Rhode Island.

Claim.—" Operating the rolls by means of the cogged segment, wheel, and spring."

52. For an *Improvement in Shaker Bars for Stove Grates;* George W. Gardner, Troy, New York.

Claim.—" The shaker bar, with the fulcrum, or its equivalent, for the purpose of revolving the grate without the usual slot in the stove, and confining the ashes in the stove."

53. For an *Improvement in Machines for Sowing Grain Fertilizers;* J. C. Gaston, Reading, Ohio.

Claim.—" The arrangement in machines for sowing grain and fertilizing materials, of a reciprocating feed bar at the required distance from the bottom of the hopper, for equalizing the supply of grain or fertilizing substance to the escape valve, and securing the said bar, hooks, or slides, by which the grain or compost is agitated and caused to escape, either in a continuous supply or at intervals."

54. For an *Improvement in Seed Drills;* Oliver C. Green, Worcester, Illinois.

Claim.—" The arrangement of the oscillating armed disks, concave, and guide ways, in combination with the aperture of the hopper."

55. For an *Improvement in Cotton Gins;* Lewis S. Chichester, Assignor to Henry G. Evans, City of New York.

Claim.—" 1st, The employment or use of the vibrating feeder-plate, having a movement towards and from the bitė of the rollers, and provided with the curved ledge at its upper end, the said ledge being serrated or provided with teeth, and placed at or near the bite of the rollers. 2d, The feeder plate, with ledge attached, in combination with the plate or comb."

MECHANICS, PHYSICS, AND CHEMISTRY.

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*Hearder's Induction Coil.**

We are enabled this week to lay before our readers some further particulars respecting Mr. Hearder's improvements in the Induction Coil, together with some of the circumstances which led to them, and we have the more pleasure in doing this, as we gather from some remarks in a recent paper published by Mr. Hearder, that he refrained from giving early publicity to his improvements, in consequence of having confided the particulars to a friend who was about to publish a work on Electricity, which, however, has not yet appeared. We rather doubt the correct policy of this course, as it might have subjected him to the chance of being anticipated by others, who, hearing of his success in some casual notices of his labors, which appeared in the early part of this year, might have had their attention drawn to the subject; and we are not quite sure that this may not still be the case.

Mr. Hearder stated, in a paper which was read by him, to the Members of the Plymouth Institution, and Devon and Cornwall Natural History Society, in March of the present year, that his attention was first drawn to the subject, by hearing of some remarkable experiments made by Prof. Grove, with a new kind of induction coil, manufactured by M. Ruhmkorff, of Paris. Having, however, learned, on inquiry, that the precise arrangement of the machine was, from the mode of its construction, enveloped in secresy, he proceeded at once to act upon his own experience, and constructed an apparatus, with all its elements distinct from each other, so as to be able to examine the function of each individual part, and ascertain the effect of modifications of any of its parts. About the middle of last year he had so far satisfied himself on the best mode of procedure, as to have arranged the different elements in such a relation to each other as to develop an extraordinary amount of statistical tension in the induced current, and he proceeded at once to experiment with this arrangement. Many of his scientific friends were cognizant of his labors, and watched them with interest. Although Mr. Hearder had thus completed his machine in the latter part of last year, he had not proceeded far enough with his investigations to be able to bring them before the public until March of the present year; but, nevertheless, he has the merit not only of being the first to construct a successful statical induction coil of this kind in England, but of having in his first attempt far surpassed the most powerful productions of the French manufacturer.

There are some peculiarities in the construction of Mr. Hearder's instrument which are worthy of particular notice, because they appear to us not only to be important advantages over M. Ruhmkorff's arrangement, but serve to indicate the correctness of the principles by which Mr. Hearder has been guided. In M. Ruhmkorff's apparatus, one part is, as it were, built upon another, and every part so thoroughly imbedded in melted shell-lac, that it would be an exceedingly difficult matter to unwind his coils to repair accidents, or to examine any alteration which may have taken place in its internal conditions. Since the power to be developed by these machines must greatly depend upon the perfect character of the system of insulation, and since there is a possibility of straining this point so far as to occasionally break down insulation even of a very perfect kind, Mr. Hearder has so contrived his apparatus as to be able to take any portion of it asunder, and thereby repair any accident that might occur from misuse or otherwise.

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* From the Lond. Mech. Mag., Dec., 1856.

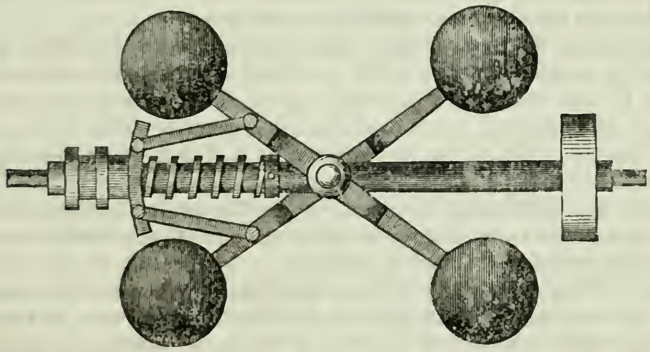
The first machine constructed by him consisted of a wooden bobbin lined with gutta percha, about six inches long in the clear of the ends, and having a hollow centre large enough to receive a primary coil with its included iron core. Upon this bobbin about a mile and three-quarters, subsequently reduced to a mile and a half, of secondary coil were wound, consisting of fine copper wire well covered with silk, and carefully varnished with shell-lac, which was allowed to dry previously to laying on. The layers were separated from each other by thin gutta percha or oiled silk. The interruptor was a very stiff spring, vibrating against a contact screw, and actuated by the end of the iron core, on the same principle as the spring of the medical coil machines. The condenser is in the base of the instrument, the coil is also furnished with a commutator for changing the direction of the current. This little apparatus, the bobbin of which is about half the length of that of M. Ruhmkorff, and the secondary wire about one-third in quantity, gave static sparks more than an inch in length in free air, and communicated such a charge to Leyden jars as to enable Mr. Hearder to make the discoveries detailed by him in a recent paper in the *Philosophical Magazine*. Since the construction of this first machine, Mr. Hearder has made a second of extraordinary power. The bobbin is 12 inches in length, and the secondary wire rather less than three miles, but, with these exceptions, the other arrangements of the apparatus are the same as in the smaller one. The length of statical spark developed by this machine, with twelve cells of a nitric acid battery, the platina plates of which are 2 ins. by 4 ins., is nearly 3 ins. in free air, and it readily produces a spark of more than 12 inches in length through the flame of burning alcohol. With it, some new phenomena have been developed, and others which have hitherto been deemed peculiar to the induction coil, have been found to be peculiar only to its mode of construction and comparatively feeble energy; for instance, with Ruhmkorff's machine, the terminal only, which proceeds from the outer end of the coil, gives static sparks to an insulated neutral conductor, whilst that proceeding from the inner end, gives no sparks, and may be handled with impunity. When the current passes between the ends of fine platina wires, the negative electrode only is heated, whereas in Mr. Hearder's machine, both the inner and outer terminals give strong static sparks which are insupportably painful, and at certain distances both positive and negative terminals are not only heated but melted. Such effects as these, obtained with a single machine, have never before been heard of; but in a recent paper in *Les Comptes Rendus*, M. Foucault states that he has succeeded in obtaining a spark of nearly 3 ins. in length, by the combined effect of four of M. Ruhmkorff's machines, but that, in order to work them in series, it was necessary to have them peculiarly constructed, as the secondary coil was not otherwise sufficiently insulated. Now, when it is considered that the united length of wire in these machines was probably not less than twenty miles, and when we find that Mr. Hearder has produced an equal effect with a single machine, containing less than three miles, there can be very little doubt that his instrument is based upon much sounder principles, and the success already attained, warrants us in believing that much more will be speedily accomplished.

For the Journal of the Franklin Institute.

Notice of a Marine Governor. Invented by Thomas Silver, Philadelphia.

Communicated by the Inventor.

The regulation of the speed of steam engines, under circumstances of various resisting loads, or different degrees of pressure of steam, has afforded a subject for experimental mechanical philosophy, until facilities for effecting that desirable object have been arrived at, that are very nearly satisfactory for the stationary engine, except in extreme cases; but heretofore, although subjected in rough seas, to much greater violence from waves, suddenly receding from the wheels, or the tossing to and fro of the ship, no efficient plan has been adopted for the regulation, in limitation, of the motion of the marine engine.



Unlike the marine, the stationary or manufacturing engine, in practical use, is throttled down to a medium or average, of about half the pressure in the boiler that supplies the force, the marine engine is supposed to be driven with all the power that the boilers can generate, when in an unguarded moment, by reason of the pitch of the ship, or variable surface of the ocean, the wheels become relieved from the water, and commence flying around rapidly, in which case, it is clear that, should the ship roll, and one wheel become suddenly plunged into the water, that the other must serve the purpose of a fly-wheel, which, aided by the whole force of the engine will, unless great strength prevent, twist off a shaft, or strip some floats from the submerged wheel, at the same time, a wasteful flow of steam occurs, which overheats the condenser, and the violence of the action, exerts a serious effect upon the journals and other parts of the machinery.

We here then, see, the need of a governor, that shall not only be entirely unaffected by any sudden temporary changes of position, but be extremely quick in its action.

The above cut illustrates a plan of instrument, invented by Thomas Silver, of this City, and patented in the United States, and also in several European governments, in 1855, and has been tested upon the United States Mail Steamship *Atlantic*, and others, with complete success.

It will be observed, that its principle of action is similar to the ordinary pendulum governor, except that it is entirely unaffected by the force of gravity, the two balls, as used in the ordinary governor, are in the present case balanced by two corresponding balls of equal weight, and placed at equal distances from the axis of motion ; the resistance to the centrifugal force being attained by the use of a spiral spring, the tension of which can be altered at pleasure, by moving the collar that is nearest the centre of the instrument, up or down upon the spindle, and staying it with a set screw. This forms a ready means of adapting the powers of the governor to the desired speed of the engine, without the calculation necessary in adjusting the two balled governor, and as it is perfectly balanced, it can be placed in any position to suit circumstances. Thus, if horizontally, it requires no bevel gearing, as only a common pulley or band wheel placed upon the spindle, as shown in the engraving, is necessary.

In practical use, it is found to overcome the serious fault of vibration that exists in the common centrifugal governor.

It is known, that if an engine that is controlled by the latter is set in motion by opening the stop valve its whole capacity, that the balls will remain in their resting places, until a speed sufficiently greater than what is required is arrived at, to overcome the necessary friction in addition to the inertia. When, having arrived at that degree of velocity, they rise suddenly to a plane, corresponding to the degree of excess, and of necessity shut off too much steam, causing the engine to slack its motion to an excess too slow, having to repeat the operation partially each way, until the maximum of speed is arrived at. The result of this defect in driving, rolling, or sawing mills, or machinery where similar changes of load are continually taking place, is, that the governor is constantly vibrating above and below the true position, at which it is striving to arrive, and seldom attaining it before again being disturbed.

But in the marine governor the balls or centrifugal weight are exempted entirely from the arbitrary effects of gravity, and the spring which resists the centrifugal force thereof, plies its tension softly at the commencement of motion, but gathering force as the speed increases, checks and retains the engine at the desired velocity.

The well know defect in the old governor, has induced the invention of many ingenious forms of throttle valves, to remedy the evil. But the inventor of the marine governor claims, that plan of valve as the best, which is the most simple and plain in construction, having regard only to being steam-tight when closed, and opening with easy movement to the full capacity of the engine to receive steam, to which it is attached.

In corroboration of this theory, we would say, that in substituting the old governor with the marine, no attention has been paid to changing the valves, although the defect, in some cases, was supposed to have existed in them.

It is now in use upon the engine of the United States Mint, that drives the rolling mills, where it works an admirable plan of puppet valve designed by Franklin Peale, Esq. This plan of valve, on account of its abruptness in opening and closing, no doubt favored the vibrations of the former governor, the frequent clashing of which, against the extremes of the guides, was unpleasant to the observer, but the quiet promptness with which the contingencies of rolling metals are met under the present arrangement, must afford a pleasure to the mechanical connoisseur.

It is also in use upon the engine of the *Public Ledger* printing office, where it works a Judson valve, the openings of which are made in a conical form as an offset to the irregular powers of the old governor. This valve has been worked both ways by it. It was applied first to open the small end of the cone, which is said to be the correct way, but for greater convenience of connexion, the crank was subsequently placed upon the opposite side of the valve stem, which reversed the opening to the large end of the cone. No difference in effect was discovered, but it gave perfect satisfaction either way.

It is also on the engine of the *New York Tribune*, working a common butterfly valve with equal result.

It is also in operation in every position, *i. e.* horizontally, perpendicularly, and in fact, otherwise; for in consequence of small and ill-shaped space, although the extreme length of the arms of the governor is only sixteen inches, it is necessarily placed upon the engines of the Steamer *Caledonia* in an inclined plane.

*On Recent Improvements in Water Metres.** By Mr. T. T. Jopling.

[Read before the Institution of Civil Engineers, Dec. 2, 1856.]

After alluding to the generic merits and defects of piston and bucket metres,—merits which were generally appreciated, and defects which were apparently inseparable from these machines, and had only as yet been partially removed,—the author proceeded to describe a metre of his own invention constructed on the piston principle, which appeared to meet the objections hitherto made to that class of metre. It consisted of two measuring cylinders, set parallel to each other, with working pistons,—the rods of which projected out of the cylinders in opposite directions, carrying at their extremities slide valve frames, for supporting and operating on the slide valves that governed the ports of the cylinders. These measuring cylinders were contained in a cast iron case or tank, into which the water to be measured entered under a certain pressure. The water thence passed into the cylinders, from which, after having acted upon one or other of the pistons, it made its escape. Through the agency of suitable counting apparatus connected with one of the piston rods, the reciprocating movements of the piston were counted, and thus the quantity of water passed through the metre, in a given time, was indicated. The measuring chambers were made somewhat like ordinary steam engine cylinders, as respected the inlet and outlet ports; but in one of the cylinders the direction of the inlet ports was inverted, in order that the right hand port might pass the water to the left hand end of the cylinder, and the left hand port to the right hand end. By this means the two pistons were enabled to follow each other in the same direction, and to maintain a continuous stream of water, without the use of cranks. The slide valves were pressed up against the ports of the cylinder, by means of springs, in order to retain them in contact with the faces when the metre was at rest. They were free to remain stationary during the greater portion of the progress of the pistons; but just as the piston of one cylinder was completing its stroke, one of a pair of tappets on the valve frame, carried by the piston rod of that cylinder, would strike against the valve which that valve frame carried, and altered its position over the ports of the other cylinder, whereby the direction of the flow of water into that measuring cylinder was reversed. For transmitting the reciprocating motion of the piston to the index, one of the valve frames was furnished at the back with two ribs, or feathers set parallel to each other, but one in advance of the other. These feathers acted as teeth, and in sliding backwards and forwards with the piston rod, they entered alternately the teeth of an escape-wheel, and so drove it round tooth by tooth. The arbor of this wheel led through the water case to the counting apparatus; and thus motion was communicated directly to it, without the aid of pawls and ratchet-wheels.

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* From Newton's Lond. Journal, January, 1857.

By this arrangement the metre became a very simple and inexpensive machine, not liable to derangement; or if injured, it was easily repaired, as the only moving parts were the two valves and two pistons. There was an entire absence of concussion; the pressure of the head was preserved, and being similar within and without the cylinder, there was no friction upon the pistons; and the water-tight external case or chamber served as a deposit for sand or other extraneous matter. These merits were admitted by the engineer of the Sunderland Water-works, where the metres had been connected with metres by other manufacturers, and exhibited identical results.

Models of Jopling's, Kennedy's, Siemens', and Chadwick's metres were exhibited in action during the evening.

In the course of the discussions, descriptions were given of Kennedy's, of Chadwick's, and of Siemens' metres. The former was described as consisting of a single vertical cylinder, wherein a deep piston worked, with a packing, consisting of a vulcanized india-rubber ring, made to roll between the piston and the cylinder, allowing for easy motion, and yet being perfectly water-tight without friction. The alternate action of the piston was communicated to the counting apparatus, by means of a rack and pinion, and action was given to the inlet and outlet valves, by means of a tumbling weight. This machine, it was contended, was very durable, and easily kept in order; the elasticity of the packing, and the peculiar rolling motion, diminished the friction; the pressure of the water was preserved through the metre; the action of the valves was regular and simple; and under the most extreme trials, the variation had never been found to exceed one per cent. The metres were stated to have been extensively employed and much approved by water-works' engineers.

Chadwick's new metre was described as consisting of three or more rollers, revolving on their axis, attached to the periphery of a wheel, the spindle of which worked in journals in two upright supports; these rollers rested upon a bag or piece of prepared leather, with inlet and outlet passages, and so fixed upon a concave bed-plate of brass, as to form the measuring chamber of the metre. The water being admitted to the bag, propelled the rollers forward, so that they each in turn passed over every part, and expressed the fluid before them by the outlet pipe. The motion was regulated by a governor, moving in an opposite direction to the rollers, and the counting apparatus was identical with that in the old metre, described on a former occasion at the Institution. These metres had not been very long in use; but, as far as could be at present seen, they might be called successful.

Siemens' metre was of the class termed "inferential" measures, and so many of them were in use that it was not considered necessary to give any minute description of their construction, beyond stating that its action was similar to that of the Barker's mill—the water entering at the centre, and being expelled through numerous curved orifices at the periphery of the revolving metre.

It was contended that the chief desiderata for high pressure metres were—accuracy of measurement under very varying pressures; free passage for the water without loss of pressure; compactness and lightness of construction; with durability and cheapness.

Good metres were made both of the piston and diaphragm class, and many did register excellently during the laboratory experiments and for short periods; but the real test was the action after twelve months' constant work, and it was generally found that some injury had occurred to piston metres, from the introduction of sand, or other extraneous matter, whereas the action of the differential metres was as perfect, after several years, as when first they were erected. Arguing that a certain force was required to cause motion, it had been stated that these metres were not capable of registering small quantities of fluid at low velocities. This was, however, an erroneous opinion, in proof of which it was mentioned, that a small house metre had registered accurately so small a quantity as half a gill per minute. These metres gained in sensitiveness as they worked,—whereas piston and other metres were liable to wear and tear; the former could be so applied as to present little more resistance than a bend in the pipe; they were so compact in form, and so small, that they could be adapted to almost any situation, however restricted; and under either high or low pressure, and with constant or intermittent action, they had been found to give satisfactory results.

It was stated, that the East London Water-works Company had two hundred of Siemens' metres now at work. They had cost, on an average, £10 a-piece; but few failures had occurred, and those quite capable of being remedied, so that casualties were likely to be even less frequent in future. They were also almost exclusively used at Bristol, where they were tested every three months, and it had been observed, that they gained from 1 to 2 per cent. The new metres were consequently adjusted so as to allow for that gain.

It was admitted that both Jopling's and Kennedy's metres had, when tested, been found to act very satisfactorily, and that, practically, they could be received as very good efficient machines, both for the water companies and the consumers.

It was shown, that there had been at least eleven distinct classes of metres, and probably not less than ten varieties in each class, which could be taken as one hundred and ten distinct inventions. They might be divided into two great classes;—high pressure metres, *i. e.*; working under the direct pressure of the mains, and delivering the water without any sensible diminution of the pressure; and low-pressure metres, which receiving the water under pressure, merely delivered it into a cistern, or other receptacle, generally situated at the top of the building to be supplied. The latter class was asserted to be generally the best, especially in those cases where the consumption was large and irregular,—as that of brewers, dyers, bleachers, calico printers, &c. Of this class, Parkinson's was said to register accurately under all circumstances of change of head, and velocity or quantity delivered. The piston, diaphragm, puff-bag, and screw-metres, were then successively described. In reference to Siemens' metre it was asserted, that it was in principle simply a turbine, or a Barker's mill, and that it partook of the errors of those machines, which no superiority of manufacture, or skill in invention, could entirely overcome. It could not register so small a quantity as would not give impulse to the machine. It had also been remarked that in some situations, it was liable to become corroded, which materially lessened the speed, and that, in some instances, the metres had actually been stopped.

Explanations were given of the cases of objections to Siemens' metres, and the question was announced to be further treated on a future occasion.

*Astronomical Expedition to the Peak of Teneriffe.**

Prof. C. Piazzi Smyth, the Astronomer Royal for Scotland, has returned from his astronomical expedition to Teneriffe, which was undertaken with the sanction of the Lords of the Admiralty, chiefly for the purpose of ascertaining how much astronomical observations can be improved by the elevation of telescopes into the higher regions of the atmosphere. In order to facilitate the inquiry, Mr. Robert Stephenson very liberally gave up to Prof. Smyth the entire use of his fine yacht, *Titania*, and its crew of sixteen men, for the whole period of the expedition. The loan of instruments of value by the Astronomer Royal, Mr. Pattinson, of Newcastle, Prof. Stokes, M. Gassiot, Mr. Nasmyth, Captain Fitzroy, Dr. Lee, and Admirals Beechey, Manners, and W. H. Smyth, also contributed greatly to the success of the expedition.

From the date of the sanctioning of the expedition by their Lordships, Prof. Smyth was closely occupied in preparing the necessary instruments (signally assisted in some of the more difficult parts by the Astronomer Royal), until the 20th of June, when he embarked on board the yacht, *Titania*, at Southampton, with about seventy cases of instruments and materials. After a prosperous voyage, during which he was enabled to accomplish, by novel, mechanical, and optical contrivances—namely, his "free revolver stand" and "spontaneous horizon point"—two important desiderata of nautical astronomy noted in the "*Admiralty Manual of Scientific Inquiry*," and to ascertain the necessity of a new but large correction for marine barometers, he cast anchor at Santa Cruz on the 8th of July. On the 10th he proceeded overland to Orotava, the real port of the Peak, while the yacht went round by sea to the same place, and landed all the packages, as well as her carpenter and second mate, who were to serve as assistants on the mountain.

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* From the Lond. Mech. Mag., October, 1856.

To determine neatly and definitely the question above mentioned as the chief subject of the expedition, in the style of a problem in pure mathematics, three stations should have been chosen; one at the base, the second half-way up, and the third at the summit of the Peak; and such had, in fact, been recommended. Prof. Smyth was prepared, therefore, to set up his instruments at Orotava as the first station; but finding that this town, and all that part of the country, were under continual cloud, thick, dense, and determinedly constant, he soon turned his attention to a higher station. He gave the preference to Guajara, a mountain 8870 feet high, on the south of the Peak, and on the 14th of July started for this place with twenty-seven horses and mules, and nearly all his baggage. Not the whole of it, for the very untoward circumstance had just been discovered that the form, size, and weight of the boxes of the great Pattinson equatorial were entirely unsuited to the means of transport in the country. He was, therefore, compelled to leave them behind, provisionally, it was hoped, while he was acquiring experience of the country, and of the astronomical qualities of the atmosphere with the smaller and more portable Sheepshanks equatorial of the Edinburgh Observatory.

Traveling, then, with his cavalcade, he began to ascend the long slope above Orotava, on a densely clouded day; but, after some hours, he had penetrated and finally risen above the clouds, the cumuloni of the north-east trade wind, at the height of above 5000 feet. This was immediately a realization of one of the astronomical advantages of elevation; for the sun now shone out hot and clear from a dark blue sky, unspecked by a particle of vapor—a state of things, too, which the characteristics of the plants and the dryness of the soil he was entering on, proved to be the rule and not the exception of that upper region. Finally, ascending through a pass in the southern wall, he and his party climbed the hill of Guajara, encamping that night among the trachyte and pumice blocks with which its summit is strewed. The morning showed that they were on the highest point of land in the island, except the Peak itself, which rose about three miles to the north of them, thus leaving the horizon clear east and west, where some of their observations were to be made. But, the site being open and exposed to every wind, and with a deep precipice, part of the old crater wall running along the northern side, their first exertions were directed to securing the station by building stone walls about the tents. To this end they procured native assistance, and erected also an optical room, a meteorological shed, and a telescope enclosure.

In astronomy, the admirable purity of the atmosphere and the advantage of an ascent of 8870 feet, were night after night proved by the limit of vision of the Sheepshanks telescope, being extended from stars of the 10 deg. magnitude to those of the 14 deg. at Guajara, and not only the brightness of the stars, but their definition also was much improved; "for, while in Edinburgh," says Prof. Smyth, "I had never seen good images of stars in that instrument, on Guajara it almost always exhibited such clean and perfect stellar disks and rings as I have never seen in any other telescope at or near the level of the sea;" and while he was still on the mountain, with almost every night perfectly clear, and in general with enchantingly fine definition, the perception of these advantages was intensified by the arrival of a letter from the first assistant astronomer of the Edinburgh Observatory, saying that there had hardly been a single clear night there during all the time the Professor had been away.

The conclusion derivable from the purely astronomical observations are confirmed by many of a different character, and especially by the observed intensity of the radiation of the heavenly bodies. Thus, the first radiation thermometer exposed was broken in a few minutes by the power of the sun proving to be so much greater than had been anticipated by the maker in England. Two other thermometers were then brought out, that had been prepared according to M. Arago's idea, and the greater strength of the sun in France; but, though marking as high as 180 deg., they were soon proved to be insufficient to register the extraordinary intensity of the sun's rays there; for by 10 o'clock in the morning the mercury had not only reached the top of the scale (180°), but was filling the upper bulb to an unknown extent.

This excessive radiation abundantly proved that Guajara was precisely the place for the normal series of actinometer observations required by Sir John Herschel. For this purpose two actinometers at least were necessary; but up to the time of leaving England neither the Prof. nor his friends could hear of the existence of more than one. That one belonged to Mr. Airey, and he not only lent it to him, but ordered a second one to be made and sent out to Teneriffe as soon as possible. Unhappily, it only arrived as he was leaving the island, on the 26th of September, and then in a damaged condition, while the other one, when opened on the mountain, was found to have been injured in its most essential part —the internal thermometer—as well as to have leaked. Means, however, of getting over these difficulties were extemporized, and observations were begun in that region so promising for solar radiation; but on the second day the gradual shrinking of the wooden parts of the apparatus split the glass parts—"the end," says Prof. Smyth, "of too many of our instruments in that climate, where, besides the direct radiation, there reigned a continual dryness, with a severity unmitigated, beyond any precedent known to the opticians at home."

Happier was the inquiry into the radiation of the moon by means of the Admiralty delicate thermomultiplier, lent by M. Gassiot. The position of the moon was by no means favorable, being on the night of the full, 19° south of the equator; but the air was perfectly calm, and the rare atmosphere so favorable to radiation, that a very sensible amount of heat was found both on this and the following night. The absolute amount was small, being about one-third of that radiated by a candle at a distance of 15 feet; but the perfect capacity of the instrument to measure smaller quantities still, and the confirmatory result of groups of several hundred observations, leave no doubt of the fact of their having been enabled to measure here a quantity which is so small as to be altogether inappreciable at lower altitudes.

(To be Continued.)

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*Photographs on Factitious Ivory.** By J. E. Mayall, London. *Patent, dated October* 24, 1855.

This invention, by the well known photographer of Regent Street, relates to the use of artificial ivory for receiving photographic pictures instead of glass or paper. This artificial material, which possesses all the properties and beautiful finish of ivory, and allows of any subsequent tinting of the image, and the obtainment of superior softness in the semi-tints, is what is known in France as Pinson's artificial ivory, consisting of a compound of gelatine and alumina. This material is prepared in the form of slabs, for the photographer's use, in this way:—The tablets or slabs are composed of gelatine or glue in its natural state, and are immersed in a bath of alumina, which is held in solution by sulphuric or acetic acid; by this means, a complete combination takes place between the alumina and the gelatine or glue. The tablets or slabs should remain in the bath a sufficient time to become thick enough for the purpose for which they are required, and to allow the alumina to entirely penetrate them and incorporate itself therewith; they are then removed and allowed to dry or harden, when they may be dressed and polished by any of the ordinary and well known processes for polishing ivory.

Artificial ivory tablets, capable of bearing a fine polish, may also be made by mixing alumina directly with gelatine or glue; but this process is not so satisfactory as the process hereinbefore described, since the thickening produced by the admixture of the alumina with the gelatine, renders the manufacture of the sheets both difficult and expensive.

Another composition of artificial ivory which is employed, consists of equal portions of bone or ivory dust, used either separately or combined, and albumen or gelatine, the whole being worked into a paste, and afterwards rolled out into sheets by suitable rolling or flattening mechanism. The sheets are then allowed to harden by exposure to the atmosphere, and are cut into slabs or tablets of the required size. But it is preferred to use two parts of fine powdered baryta, and one part of albumen, well worked together, and rolled out into slabs. The best plan hitherto discovered for working the materials together, is that commonly used in the manufacture of Parian marble; this composition may also be used spread upon paper, if desired. These slabs or tablets are then carefully scraped, to give them a perfectly even surface. They are then washed with alcohol, to remove any impurity therefrom, and are prepared in the ordinary manner to receive positive pictures. The pictures having been printed, the entire slab or tablet may be immersed for a few minutes in a weak solution of nitro-sulphuric acid or nitro-hydrochloric acid, for the purpose

* From the Lond. Prac. Mech. Journal, Jan., 1857.

of rendering the picture more clear and brilliant. It is then fixed in the usual manner with hypo-sulphite of soda, and is washed, and then dried on a marble or other slab, or under pressure, to prevent it from warping.

*Improvements in Knitting Machinery.**

Besides the great inventions which startle the world at their first announcement by the magnitude of their expected results, there are others of more modest pretensions which should have interest for us from the stimulus they give to further improvement. In the present number we publish a selection from the more recent of the enrolled specifications, relating to the manufacture of knitted fabrics, for the purpose of showing the direction which invention is taking in that branch of industry. This example of progress is an apt illustration of the relation which a new idea struck out bears to succeeding improvements; and as such, it may be well to consider the case here presented to our view; for the advance made in knitting machinery, though slow, and silently effected, is still worth calling an advance—inasmuch as the speed of production has been greatly increased, though much yet remains to be done to bring the hosiery manufacture on a par with that of lace or woven goods. The most notable improvement in knitting machinery effected during the present century, is the introduction of the circular knitting frame: this was hinted at by the late ingenious mechanician and engineer, Sir Isambard Brunel, and a machine designed on this principle was even patented by him in the year 1816; but nothing came of this valuable suggestion, and it was forgotten, if ever known by the trade, only to be raked up and brought against the inventor of the first successful circular machine; who, being a foreigner (a Belgian we believe), patented his improvements in England in 1842, as a communication to Mr. Tielens. Quickly following upon this were a series of improvements introduced by M. Claussen, and patented by him in the years 1845 and 1847. The utility of this ingenious mode of applying rotary motion to the working parts of a knitting machine, was fully demonstrated some six years ago; and the French department of the Great Exhibition of 1851, gave further proof, if that were wanting, of the efficiency of that class of machinery. Among the group of seven specifications selected to illustrate the recent progress of the knitting manufactures, it will be seen that five relate to circular machines; thus marking the estimation in which the original idea of Brunel is now held by the trade. But there is another circumstance worthy of note as showing the value of a casual hint, and that is, the use which several of these patentees now propose to make of the well known double-headed and hinge-bearded needles. Their application is not even confined to our own manufacturers, for an inventor, from the other side of the Atlantic, proposes the introduction into a circular machine of the hinge-bearded needle, and that apparently under the idea that he is the originator of the needle as well as the means of using it. The credit of introducing the double-headed needle, which permits of the manufacture of ribbed fabrics with like faces on both sides, is due to Messrs. Townsend and Moulden, who, in 1849, patented this improvement, and with it the jointed or hinge-beard, which enables the formed loop to be pushed off the needle without the use of a presser-bar for depressing the needle beard and allowing the loop to slide over it. Trifling as these improvements may appear to one not engaged in the trade, we get to understand far better their value and the credit due to their originators, when we see them used by other inventors as the stepping-stones to further improvements. Whether the time is ever again to return when inventors will resume their proper place in the estimation of mankind, we know not ; but appealing as we do to a public that can rightly appreciate the labors of others in quickening the pulse of industry, and through it of commercial enterprise—we care not to count with those who ignore the existence of the men to whom we are indebted for the ever increasing benefits presented to us, either in the form of cheaper or better, or hitherto unknown articles of manufacture, or of increased facilities of transit for ourselves, our goods, or our thoughts and wishes. This, therefore, must be our excuse, if any were needed, when we point attention to unpretending improvements which have neither been trumpeted to fame by injudicious friends, nor decried and denounced into public notice by as injudicious enemies.

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* From Newton's Lond. Journ., Nov. 1856.

Messrs. Townsend and Moulden's needles, which offer the advantages above stated, are designed by four out of seven of these patentees, to take the place of the ordinary needle. But while the existence of the old stocking-frame, as left to us by the Rev. William Lea, is threatened, we find another inventor stepping forward to rescue it from oblivion, and impart to it new vitality by the addition of the Jacquard apparatus. It would astonish the original inventor of this beautiful contrivance, whereby an apparent intelligence is imparted to inanimate matter, could he but see the uses to which his great discovery has been already applied. After performing wonders on the loom, it was, comparatively lately, introduced to the lace machine, and with the like results ; and now, thanks to Mr. Turner, of Leicester, it is brought to act upon the needle beards of the common stocking-frame, and produce patterns in the fabric with the greatest ease. We look with interest on the success of this suggestion of Mr. Turner, for it is a move in the right direction, and shadows forth, as we believe, a new era in the manufacture of hosiery ; for the Jacquard being once successfully applied, and varieties of patterns produced with facility, the demands of the public will become more exacting, and progress will necessarily result.

Dyeing.

M. Fr. Kuhlmann having remarked that when eggs were dyed, some of them took the colors better than others, and that this fixation of the color took place without any mordant, was led to suppose that, in these cases, the fixation was due not to the calcareous salt of which the egg-shell is formed, but to an azotized coating upon its surface. This supposition was verified by experiment. As the coating of the egg-shell is very analogous to albumen, this latter substance, coagulated by heat, was tried separately in baths of Brazil wood, &c., and its absorbing power thus shown. M. Kuhlmann then tried the use of this substance, for the purpose of increasing the absorbing power of different tissues; he obtained very favorable results with cotton, less distinct with silk, scarcely perceptible with wool; these trials were made with Brazil wood, madder, and Campeachy wood. After albumen, he tried with the same success milk and caseum, which may be coagulated on the surface of the tissues by means of an acid. Milk, especially alone or in connexion with mordants, gave the cotton very full colors. He experimented also upon gelatine coagulated by tannin, and obtained results, although feeble, without mordants. He also showed that albumen may serve as a medium for precipitating upon stuffs, metallic oxides, with which it forms insoluble compounds; in dyeing, stuffs impregnated with these compounds, absorb colors with more ease than if they had been prepared either with albumen, or with the same metallic salts alone. Analogous results were obtained with tannin-gelatine.—*L'Institut*, 26*th November.*

Specifications of a patent granted to Alexandre Tolhausen, *for a new process of producing chemical writing, and of marking and inscribing chemically, any characters or figures upon paper or other substance of similar character; being a communication.*—Dated March 26, 1856.

This invention consists in a process for producing chemical marks or writing on paper, without using a liquid like common inks, by employing chemically prepared paper, and a chemically prepared pencil, style or other like instrument, to trace, write, or mark on the paper, whereby the salts or substances in the pencil and paper, when they come in contact, will chemically unite under hygroscopic conditions at the natural temperature of the atmosphere, and will form visible chemical colored marks or writing on the paper. Hygroscopic conditions are necessary to the process to effect chemical writing: moisture is the agent which enables the salts or substances used to effect chemical union, but no liquid is employed.

To prepare the paper, the common sizing that is used for writing paper is saturated with a salt or salts, or substances of considerable solubility, and which, when dried with the paper, will maintain its dryness and freedom from moisture under ordinary atmospheric changes. Colorless salts or substances are preferred for this purpose, or they may be of such a light tint as not to be different from the color of writing paper. This salt or salts, or substance, is to form the ground for the colored marks or writing to be produced on the paper. Various salts may be used for this purpose, according to the color of the marks or writing to be produced: For instance, to produce blue marks or writing, the paper is prepared with ferrocyanide of ammonium, which is very soluble in water, or with salicylic salts. To make black marks or writing, indigolic

* From Newton's Lond. Journ. of Arts and Sciences, Nov. 1856.

salts, euxanthic salts, and morphine salts are used. To make red marks, meconic salts, kemenic salts, pyromeconic salts, and angelic salts are used. To produce green writing or marks, the paper is prepared with caffeic or themic salts. These salts, either singly or a mixture of those specified for each color, are mixed with the sizing of the paper, which is applied in the usual manner, and the paper is afterwards dried and pressed in the common way. No certain quantity of these salts requires to be described, but about one ounce of any of them is sufficient to impregnate the sizing for about half a ream of common foolscap paper; a lesser quantity being used to produce feebler colors, and more to produce darker shades. Other well known salts than those specified may also be used, but those named will effect the results herein described—the principal feature of this invention being to produce chemical writing without an ink. The patentee now takes a deliquescent salt, and, for cheapness, he prefers a ferric oxide—the nitrate, chloride, or sulphate of iron, obtained in any of the usual methods. This salt is triturated and mixed intimately with plastic clay, in about the quantities of an ounce of salt to a like quantity, by weight, of clay or similar substance. The ferric clay is then moulded into any desired form to constitute a pencil or tracing instrument, and is afterwards baked in an oven, to drive off the moisture by heat. The heat is continued, at about 212° Fahr., to drive off all the moisture and to harden the clay. When this is accomplished, the ferric pencil or tracer is removed from the oven or other place, and plunged into molten bees-wax, spermaceti, or any substance of similar character, which will form an air-tight coating, and not decompose the ferric salt. The chemical pencil or tracer, thus produced, may be placed between strips of wood, like a common lead pencil, or it may be placed in a metal pencil-case, and the point of it scraped to expose it to the air. The chemically prepared paper, previously described, is now traced, pressed, or written upon with the pencil or instrument described. The ferric salt in the said pencil, during the act of writing, when exposed to the atmosphere, absorbs moisture; and when it (the ferric salt) comes in contact with the salt or substance in the prepared paper, the salts or substances in the pencil and paper unite chemically (forming double decomposition), producing a new ferric compound in the prepared paper, and thereby producing chemical colored characters, marks, or writing. Any of the ferric salts named for the pencil will produce the different colors mentioned on paper prepared with the substances heretofore specified for producing these colors. The pencil or tracer may also be made of a very porous substance, which may be steeped in a solution of ferric salt, then dried to expel the moisture, leaving the salts in fine crystals in its pores: it is then plunged into bees-wax, as described, for the above described pencil, and for the same purpose. Type may be formed in the same manner as the ferric clay pencil described, and chemical printing may be executed without the use of common topical ink, which in some cases may be advantageous. A very porous fountain pencil may also be made, one whose pores will permit fine ferric salt to percolate as it were through them, and be transmitted to the paper in the act of tracing or writing, and impressed on the paper by a hard point on the pencil, to bring the salt or salts in the pencil and prepared paper into contact, when the two will unite under hygroscopic conditions of the ferric salt, and produce the chemical marks and writing heretofore described.

Another method of obtaining the hygroscopic condition necessary to form a chemical union between the salt or substance in chemically prepared paper and a pencil, without employing a deliquescent salt to produce chemical writing on paper, is to use glycerine as a component part of the chemical pencil or marker. Without the employment of a solution it will afford the same requisite amount of moisture as a deliquescent salt. Paper prepared with starch, as a sizing, will produce blue marks or writing, if it be traced upon with a porous pencil or fountain pencil containing iodine and glycerine—the latter not being present as a liquid, but simply as a hygroscopic agent.

Another method of producing the same chemical marks or writing on paper as those described is, to prepare the paper in the same manner as that first described, and employ a dry salt in the pencil, and supply the hygroscopic conditions necessary to form the chemical union of the chemically prepared paper and pencil during the act of writing or tracing, by placing a moist sheet of paper under the paper to be written upon; or they may be supplied, after tracing or writing, by pressing a sheet of moistened paper on the written or traced surface; by either of which acts the salts will receive the necessary supply of moisture to enable them to form double decomposition, and produce chemical marks or writing on the paper. The salt or salts preferred for making the dry salt chemical pencil, for producing chemical writing or marking, of the character described, are the tartrate of iron, the terpersulphate of iron, or any of the permanent iron salts.

Heretofore it has been a desideratum to obtain a superior substitute for the common lead or plumbago pencil and the crayon, and also for the method of writing with a fluid-like ink. The lead pencil and crayon only make mechanical marks, which are easily erased; and writing with ink is troublesome, because the pen has to be often replenished.

This improved method or process will produce chemical marks or writing equal to those made by inks; and the method of writing or producing them is as easy as the act of writing with a common pencil. It will be a superior method of writing on books and bills, and making permanent records on paper. It will afford security against alteration of the writing on records, as it will require the specific salts in the pencil and paper to produce a writing similar in color and shade to that which is attempted to be supplanted, changed, or altered, and to that on the part of the document written upon. This process obviates the evils and objections incident to the use of a common pencil or pen and ink.

The patentee claims "producing chemical marks, records, or writing, on chemically prepared paper, as described, by tracing, pressing, or writing with a chemically prepared pencil, style, tracer, type, or other suitable instrument, on such paper, under the hygroscopic conditions herein described, or in any manner substantially the same."

*Wright's Improvements in Manufacturing Boilers, Iron Ships, etc.**

In the ordinary manufacture of cylindrical boilers, the plates are so arranged that the riveted joints run in lines parallel to the axis of the boiler, and in planes perpendicular to the axis; or, in other words, the joints run in the direction of the length of the boiler, and at right angles to it. The joints running parallel to the axis of the boiler, or the longitudinal joints, it is well known, are subjected to a greater strain than those crossing them at right angles and running round in planes perpendicular to the axis, and consequently the longitudinal jointing is the weakest, and the part of the boiler first to give way under great pressure.

In order to remove this defect, Mr. E. T. Wright, of Wolverhampton, has patented an invention which consists in so arranging the riveted joints of boilers, and other articles of similar manufacture, that they shall not run parallel to the axis, but in a line oblique thereto, the lines of plates being made to run round the axis of the boiler in a helical or corkscrew direction, and the joints either at right angles to one another, or varying from a right angle, so as to be oblique to the direction of the greatest strain. "By thus placing the lines of riveted jointing oblique to the direction of greatest strain," says Mr. Wright, "any given amount of such greatest or lateral strain is resisted by a greater length of jointing, and consequently greater number of rivets, than when such line of jointing is situated parallel to the axis of the boiler, whilst the whole length of jointing and number of rivets in the boiler is not increased, or is increased only to an inconsiderable extent."

Fig. 1 of the accompanying engravings represents in side elevation a cylindrical boiler of the improved construction, with hemispherical ends.

Fig. 1.

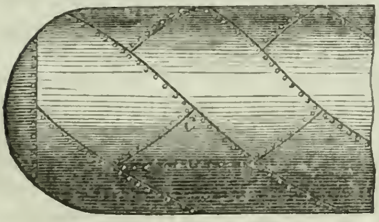
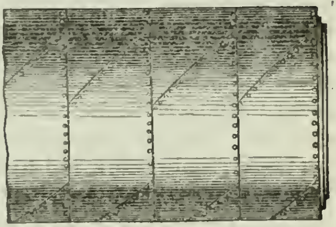


Fig. 2.



The oblique position of the joints and the arrangement of the plates in the form of helices are so clearly indicated that a further description is not necessary.

"The amount of increased strength of joint will appear," says Mr. Wright, "on referring to fig. 1. The dotted line, *a b*, will represent a given length of lateral strain, say 1 yard. This amount of lateral strain, instead of being resisted by only one yard, or an equivalent length of jointing, it will be perceived, is resisted by a length of jointing represented by the two lines, *a c* and *c b*, together equal to 1414 yards."

Fig. 2 represents, in side elevation, another cylindrical boiler. In this the plates are disposed in the usual manner, but they are not rectangular, but of a lozenge shape, or have ends which, although parallel to one another, are not at right angles to their sides. Mr. Wright does not, however, consider the mode of construction shown in fig. 2 to be so desirable for boilers as that shown in fig. 1, because the length of jointing in the boiler is increased.

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* From the Lond. Mech. Mag., Nov., 1856.

The application of the invention to iron ships, &c., consists of an oblique arrangement of the riveted joints, similar to that before described and illustrated.

*Experiments on Iron Targets.**

Some experiments have been made at Woolwich, to test the power of resistance of timber lined with 4-inch iron plates—the combined materials being of the same thickness as the immense floating batteries constructed during the late war; and also to test the durability and quality of iron plates manufactured by rolling, as compared with iron turned out by the hammer. The target was an immense construction of timber, lined with 4-inch plates of iron of both descriptions, and the total weight was 30 tons. This target was placed on a foundation constructed for the purpose, and 24 rounds of 68-pounders were fired with the following results:—The first 14 rounds were fired at a distance of 600 yards, and after the first few rounds the timber work gave way in several directions. The last 10 rounds were fired at a distance of 400 yards, and the work of destruction commenced was now consummated. The timber work of the target was completely broken and splintered, and the plates of iron made by the rolling process were cut up and split, having apparently but little adhesion. The iron plates which had been made by the old process resisted the solid wrought iron shot much more successfully, and it was apparent that these plates possessed more adhesive power than the rolled plates. Such was the tremendous force of the cannonade that the immense target was forced by the concussion several feet from the foundation or box on which it was placed. The last shot fired was the most effective. This shot went completely through the target, timberwork and iron included. It was the subject of remark by several practical men that the principle of combining timber with iron plates, was, no doubt, the best that could be at present adopted; but it was evident from these experiments that such plates must be improved upon before they could resist the concussion of repeated discharges of heavy shot.

The Laws of the Strength of Wrought and Cast Iron.†

A paper on the above subject, was read at the Institution of Civil Engineers, on Tuesday, December 9, by Mr. William Bell.

In this paper, it was stated, that the chief point had been the consideration of the longitudinal, as compared with the transverse, strength

* From the Lond. Mining Journal, No. 1113.

† From the Lond. Mech. Mag., Dec., 1856.

of wrought and cast iron. For this purpose the whole of the experiments made up to the present time, on tearing asunder or crushing bars of cast iron, and those made by breaking bars transversely, had been taken, and from them, and the known formulæ of elasticity, such values of the constants in the formulæ had been deduced, as would satisfy each experiment individually. And by comparison a general view of the accordance or non-accordance of theory with experiment had been obtained, and some general laws arrived at.

The mathematical theory of elasticity, as given by Poisson and Navir, was assumed. By finding, for each experimental beam, the centre of gravity of the area of cross section, through which, according to this theory, the neutral axis passed, and calculating the moment of the forces with respect to this axis, the application of the formulæ to the experiments was easily made.

The first constant obtained, was the weight per square inch of the modulus of elasticity, and this, when deduced from the transverse strain, was taken from the deflexions produced by small weights, and in all cases where the beam or bar was very little strained. For wrought iron, the most comparable experiments were considered to be those detailed in the "Iron Commissioners' Report," which gave, by transverse strain, from 12,200 tons to 12,750 tons per square inch, and by extension of bars from 12,200 tons to 12,900 tons per square inch. For cast iron the averages of Low Moor, Blaenavon, and Gartsherrie irons were from tension 6305 tons, from compression 5698 tons, and from transverse strain 5968 tons per square inch. Other experiments on the transverse strain of wrought iron gave from 9000 to 14,000 tons per square inch; whilst with cast iron the results were found to vary from 4000 to 8000 tons. On this point, it was stated, that Mr. W. H. Barlow, F. R. S., M. Inst. C. E., in some experiments on the neutral axis, recently laid before the Royal Society, found results nearly agreeing with the higher number.

Another mode of arriving at the value of the modulus of elasticity, by means of the bending or breaking weight of "long pillars," was also examined; the ratios of the lengths of the pillars to their diameters being taken as abscissæ, and the bending weights, obtained both from theory and experiment, as ordinates. It was thus found that, for the experiment on wrought iron pillars given in the before-mentioned report, the curve of theory agreed very well with the curve of observation, until the length became shorter than seventy times the thickness. The experiments on cast iron pillars examined were those in the second volume of "Tredgold on Cast Iron." The correspondence with theory was very good for those with the ends rounded, until the length became shorter than twenty times the diameter; and for those with the ends flat, until the length became shorter than fifty times the diameter. The hollow cylindrical pillars, with one exception—that of a short pillar—gave values for the modulus of elasticity of from 4350 to 6680 tons. The correspondence between theory and experiment seemed, in the author's opinion, to warrant the conclusion that the theory was perfectly trustworthy when only small compressions and extensions were concerned.

The fundamental assumptions usually made in the theory of the strength of materials were then considered. First, that in a beam strained transversely, the extensions and compressions of the particles were proportional to their distances from the neutral axis. Second, that the extensions and compressions were proportional to the tensile and compressive forces—known as Hooke's law, and by the phrase, *ut tensio, sic vis.* And third, supposing the latter law to hold good, that whenever in a beam subjected to transverse strain, the tension or compression on the outside particles was the same as would be obtained by direct experiment on pulling asunder or crushing bars of the same material, the beam gave way. It appeared, however, from experiment, that for large compressions and extensions, the law of Hooke ceased to be applicable. It was found that in cast iron, this law did not differ widely from the truth within the range of the experiments; whilst in wrought iron, although the difference was great near the point of rupture, yet the curve of compression was similar in form to the curve of extension, the ordinates likewise being nearly equal in amount. The true law might, therefore, be roughly expressed by saying that, beyond a given amount of force, the same force corresponded to all compressions and extensions, this force being nearly the force of rupture, either by longitudinal compression or extension: in other words, the force was scarcely altered by a large increase of the compression or extension. It was next considered what effect this deviation from the law of Hooke would have, as to the force on the outside particles, as deduced from that law; the supposition being made that the force was constant, and therefore equal to the force of rupture for all compressions or extensions. From this investigation, the author thought it would be obvious, that the supposition of a constant force was different from the truth in one direction, while the law of Hooke was different from it in another, so that these two laws formed limits between which the truth always lay; in cast iron the latter law being more nearly approximated to it. It was shown that the results derived from experiments, by assuming the ordinary law, were slightly above the truth, the difference, even in a rectangular section of wrought iron, being probably less than 20 per cent., and in cast iron still smaller, while in large box and double T girders with a broad bottom flanch, the difference was practically insensible.

The other constant obtained was the value in tons per square inch of the tension and compression of the outside particles, when the beam became ruptured by transverse strain. For wrought iron the experiments on solid iron bars were fewer than could be wished, and gave results varying between 14½ and 18½ tons per square inch. In this material it was thought that it might probably be the compressive, rather than the tensile force which determined the fracture. The only experiments on the direct compression of wrought iron were those on two bars, given in the Iron Commissioners' Report—where one gave way under a strain of 14·5 tons, the other under 13·8 tons per square inch. The quality of iron was not stated, but it was believed to have been soft. It was asserted that the better kinds of wrought iron were able to sustain a greater tensile force, the worse kinds a greater compressive force. According to Mr. Eaton Hodgkinson's experiments, wrought iron might be defined to have its tensile to its compressive force, nearly in a ratio of equality; cast iron to have those forces in a ratio of about one to six.

This being so, it was thought worthy of consideration, whether in the plates of a large wrought iron bridge subjected to compression, a slightly inferior quality of iron might be used, not only as more economical, but as better in itself.

With regard to riveted iron, the results from all the wrought iron tubes in the before-mentioned report, gave from 7·1 to 21·8 tons per square inch. The lower numbers were apparently caused by using thin plates for tubes of comparatively large diameter. If this were avoided, it was thought that in calculating the strength of wrought iron tubes, 15 tons per square inch might be allowed for the breaking force on the outside particles.

When the experiments on cast iron were examined in this manner, the following fact became apparent; experiments on small bars broken transversely gave results of 20 tons, and even more, for the tension and compression of the outside particles, when the experiments were examined by the ordinary theory. If these results were diminished by 20 per cent., which it appeared would more than make up the difference caused by assuming the ordinary law, there was still a result of, say 16 tons, while by direct experiments on the tensile force of cast iron, 7 or 8 tons were found to be the utmost that it would bear. In regard to this subject, Mr. W. H. Barlow had adduced the alternative hypothesis that the neutral axis shifted its position as the beam became strained, and that when rupture took place the neutral axis was "at or above the top of the beam." This hypothesis was considered by the author to be contrary to the elementary principles of mechanics; for as the sum of the compressive forces on one side of the axis must be equal to the sum of the tensile forces on the other, therefore if there were tensions on one side of the axis, there must be an area out of which to get compressions sufficient to balance them on the other. As evidence on this point, in one material, the observations of Sir David Brewster in passing polarized light through a piece of glass subjected to transverse strain were alluded to.

In experiments on the direct tensile strength, it was assumed that the outward force was uniformly distributed over the area of the bar; in other words, that the resultant of the external forces acting on the bar, passed through, and had the same direction with the axis. This probably obtained in wrought iron from its great extensibility before rupture; but in cast iron there was no such extensibility, and this point was, therefore, to some extent, doubtful. If a few experiments were made, in which the force deviated from the axis by certain large and measurable amounts, and then were made to approach the axis, until some law was obtained which could be tested, this point would be set at rest. A table was then given, showing the values of the forces on the outside particles at the time of rupture, in tons per square inch, from which it appeared that there was a diminution as the size of the beams increased. Beams 3 inches by 3 inches, as compared with those of 1 inch by 1 inch, showed a falling off of strength to the extent of about 4 tons per square inch. The results derived from Mr. Hodgkinson's and Mr. T. Cubitt's experiments gave about 10 tons per square inch, when the sound beams only of the latter experimenter were included in the calculation, or 9·6 tons per square inch when the unsound beams were taken into account. From this table it appeared, that the breaking weight of tolerably large girders might be calculated with considerable accuracy, by using 7 or 8 tons per square inch as the force of tension on the outside particles, when rupture took place.

In conclusion, the author expressed the hope that he had succeeded in establishing the following propositions:

First. That in experiments where the materials were but slightly strained, theory and experiment coincided.

Second. That where the ordinary theory was applied to the rupture of beams, and especially large beams, of wrought iron, theory and experiment practically coincided.

Third. That there appeared to be no good reason for supposing that the neutral axis shifted its position to any extent worth noticing, even up to the time of fracture.

Fourth. That in cast iron, although theory seemed to differ from experiment, when the transverse strength of small bars was compared with the direct tensile strength, assuming the latter to be correctly stated at 7 or 8 tons per sq. inch, yet when the transverse strength of large girders was compared with the direct tensile strength, the coincidence of theory and experiment was nearly exact.

Fifth. That the ordinary theory of the strength of materials was more trustworthy than was generally supposed.

In an appendix, the author explained the formulæ used in examining the experiments, and gave the demonstrations of the results arrived at; the experiments for ascertaining the modulus of elasticity, and the forces on the outside particles at the time of rupture, being examined in great detail.

Substitute for Iron Pipes and Brick Sewers.[*]

The heavy cost of iron mains or pipes, and the great expense of laying them in trenches under roads, together with their short duration (from oxidation), liability to flaws, fractures, defects in joints, &c., are disadvantages universally felt; and the interruption of traffic, consequent upon the almost constant repairs going on in the streets, is so serious an evil, that it is absolutely necessary some remedy should be devised, particularly in the metropolis. It is also now considered imperative that the public generally should be provided with a more copious supply, and better quality of water, than heretofore, and that the sewage should be quickly collected and as quickly removed. For the attainment of these objects, substantial and imperishable conduits or tunnels are essentially necessary. The iron pipes and brick sewers now in use, are not adapted to the purposes—the first being costly, rapid in decay, and rendering the water impure; the last, although less costly, absorbing the sewage, and retaining much of the foul matters intended to be removed and discharged, and eventually becoming a mass of corruption. To provide a substitute, which shall be equal if not superior to the famed Roman conduits and aqueducts, has occupied the attention of Mr. William Austin, for many years past, and he has at length produced and patented an imperishable and economical material in blocks of peculiar form, for the rapid construction of conduits, aqueducts, sewers, tunnels, well-pits, mine-shafts, towers, light-houses, and similar cylindrical constructions. The blocks are also available for walls of buildings in general; also for wharves, sea or river walls, docks and harbors; in which latter case a straight-faced block is provided, dovetailing in its bed and end joints (perforated if required), and forming a compact, immovable, indestructible, rocky mass, proof against the action of salts, acids, frost, or fire.

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[*] From the Lond. Civ. Eng. and Arch. Journ., Dec., 1856.

Fig. 1.

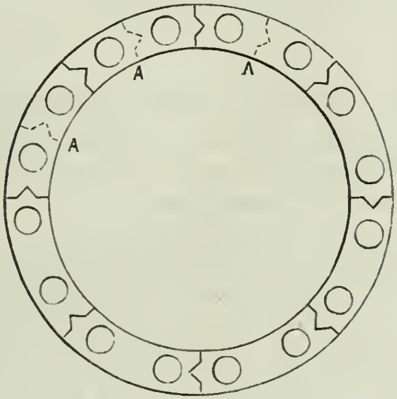


Fig. 2.

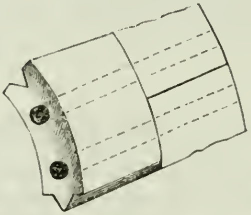


Fig. 3.

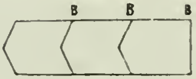
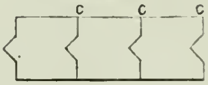


Fig. 4.



In the accompanying diagrams, fig. 1, when viewed vertically, shows a plan of a tower or shaft, and viewed horizontally is a section of a tunnel, aqueduct, or conduit, formed of these blocks, showing at A, A, A, the bonding of alternate joints, as indicated by the dotted lines. The orifices come opposite to each other in succession, as seen in fig. 2, which is a perspective view of the circular block; and through the orifices, bolts, chains, dowels, or grout can be passed or run to act as ties. The blocks also dovetail in their ends or beds, as seen at B and C, figs. 3 and 4, securing additional strength and stability, and becoming a locked and immovable structure, of a character somewhat similar to the vertebræ of animals.

These blocks can be cut in a soft working stone, and then by induration be rendered intensely hard and impervious to moisture or frost; or the blocks can be formed in iron moulds from indurated pulp, made from sand, chalk, pebbles, gravel, brick-dust, road scrapings, and which, not requiring to be burnt in a kiln, are consequently not liable to torsion or twisting, but remain perfect fac-similes of the various iron moulds or shapes.

The application of these blocks has been suggested by Mr. Austin, in connexion with his project (which has been laid before the Metropolitan Board and the public), for removing the whole of the metropolitan and suburban sewage by conduit tunnels under each shore of the Thames.

All the sewage now discharges into the river: it would then, as proposed by him, be carried below each mud-bank without any interruption; and if the under-shore tunnels be extended from Fulham to the mouth of the Thames, every particle of the valuable sewage, when properly deodorised in its onward progress, would be eagerly sought for and applied to the poor and waste lands of Kent and Essex on each side of the river. Mr. Austin suggests boundary or limit-width walls for the Thames water, having the conduit tunnels as footings for such walls, to prevent overflowing on each shore, and to redeem the waste marshes, converting them into corn and crop lands. Two important advantages would thus be combined—"the removal and useful application of sewage," and "the rendering the Thames a most handsome commercial river."

Extract from the Specification of a Patent granted to Isaac Abraham Boss, *of London, for Improvements in Preparing Cane in order to render it Suitable to be Used as a Substitute for Whalebone.*[*]—Dated April 29, 1856.—(A communication.)

This invention has for its object, improvements in preparing cane in order to render it suitable to be used as a substitute for whalebone. For which purpose the cane is first cut by being passed between two circular saws, the cane being moved past the saws by two grooved rollers, and it is supported by a grooved bed or guide, on to which it is pressed by a pressing roller. The canes having been properly cut on four sides, they are to be impregnated with a preparation of animal matter, which is obtained as follows:—Bones are steeped in a solution of chloride of lime, the bones having afterwards been dried, are softened by digesting with steam, they are then combined with a solution of alum, and the filtered liquor obtained is employed for impregnating the canes, by placing them in a suitable closed vessel with such fluid, and subjecting the same to a pressure of about twelve atmospheres. After the impregnated canes have been dried in currents of air, they are soaked in a solution of alum, and again dried and finished for use.

On the most Convenient System of Measures and Weights, based on the Natural Pace of Man.[*] By C. A. Henschel, of Cassel, Germany.[†]

Since the nations of the civilized world, urged on by a new state of things, are progressing and mutually competing in arts and sciences, in commerce and industry, and all are beginning to enter into intercourse with each other, it is no longer sufficient that each of these states should have its own peculiar yard or pound, which it may have decreed according to its own convenience. In future, nothing less than a general agreement on one and the same system of weights and measures is likely to meet the wishes of all concerned.

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[*] From the Repertory of Patent Inventions.

[†] From the Lond. Civ. Eng. and Arch's. Jour., June, 1856.

[‡] Translated from the German: being an abstract from a pamphlet, in which the said system is projected according to, and in connexion with, the metric system.

That an agreement of this kind is becoming indispensable in modern times, has been pretty generally conceded, though as yet it has never been taken into serious consideration, owing partly to the obstacles in the way of introducing it being considered insurmountable, partly to a misconception of a measure which nature herself has indicated in the construction of our own body—namely, the pace of man, which is not only necessary to accomplish locomotion, but is also clearly indicated as being the most proper for taking measures. People began to think that the length of the human foot, instead of the pace, would prove the most desirable measure, and accordingly the same was fixed, but differently in each place, without having regard to uniformity; so that a multiplicity of measures was gradually brought into existence, from which state of things we have suffered since the building of the tower of Babel to the present day. None of the measures thus introduced and adopted for the transactions of daily life, such as the yard, cord, &c., are capable of affording that convenience and simplicity which the natural pace possesses, not excepting even the metric system, constructed with all the advantages which science has been able to offer.

In spite of all that has been done to systematize and fix the metre, and the admirable exactitude in pointing out and determining some foot-measures, such as the Prussian foot, determined by Bessel in the year 1816, the soldier, in all parts of the globe, constantly exercises and manœuvres by paces. He hurriedly takes his measure of the ground by paces, and by the same process he, as well as the sportsman, takes his shooting distance. In the same way, geometers take sketches for complicated details; and by exactly the same process, the traveler measures and marks the length of remarkable edifices, places, vessels, &c. Nay, even in common conversation we are more easily understood if moderate distances are described in paces; and all for the obvious reason that, by means of our daily practice of pacing, the length of the pace is always the most clearly before our mind. But, at the same time, people have unfortunately been guilty of inconsistency in adopting an artificial unit of measurement for other dimensions of one and the same object, particularly the height of houses, towers, masts, trees, mountains, and hills; thus the relation between length and height, which is far more important than the absolute size of these dimensions, has been disturbed to such a degree, that the intended clear perceptibility of things cannot be accomplished unless by a tedious reduction of figures. The simultaneous use of two measuring units (not to mention the legion of others) is, therefore, it must be conceded, a great evil, calculated to render most difficult all insight and judgment, whenever such must be taken instanter; and our wishes for a uniform system are silenced by our having become accustomed to believe that it cannot be otherwise. Fortunately, however, the evil alluded to is not a necessary one, for, having created it ourselves, under a false view of things, it will be admitted that we are at liberty to do away with it, after having gained a juster conception of the subject. And we can abolish the evil by adopting a measure of exclusive validity, than which nothing is better adapted to meet the exigency—namely, the pace, owing to its peculiar convenience for the use of man.

The process of measuring will thus be brought to its third and last stage, that of convenience and simplicity; and the only problem yet to be solved will be to qualify the pace of man for an exact measure by properly determining it, as the same has been used since the earliest ages of man for an approximative measure; and finally to construct on that basis a system of weights and measures analogous to the metrical system, which would be most capable and sure of being easily introduced, owing to the metrical system now being pretty generally known.

In order to ascertain the average length of the human pace, the author has counted the paces of many persons, made on a piece of ground which had been previously measured and was clearly perceptible from his room ; and as those whose paces he studied were not aware of being observed, their pace was as natural as could be desired. The average of 100 observations gave the result, that the length of the pace is equal to 800 millimetres, with few very slight differences. Further observations were made by some officers, who took an interest in the matter, and noted down the movements of troops on the road. If the regiments of the guards are excluded, owing to the unusual size of the men, the result of the military observations coincides precisely with the measurement of the average pace of civilians, viz: =800. This average length of pace, so well determined in figures by 0·8 metres, as well as the almost exact harmony of the result of both trials, cannot be considered as being the consequence of a natural relation between metre and pace, but only as a favorable coincidence, which, in this instance, is very welcome, because the introduction of a normal pace-measurement will be greatly facilitated by the aid of the metre. At the same time, all those who consider the metre essential as a constant natural measure, and are wont to regard the number of 40 millions of metres as being the circumference of the globe, will be satisfied when they see that such number can be just as well expressed by 50 millions of paces.

As regards the subdivision of the normal pace, the metre and other decimal measures having preceded, it must be admitted, without hesitation, that it will be best to regulate the pace, according to the decimal system, excepting, perhaps, those measurements, which in the daily transactions of the retail trade, at market, in shops, &c., can be most conveniently arranged by continuously halving measures and weights. In the first place, therefore, the pace is to be divided into ten equal parts, which tenths (being about the breadth of the human foot) we may name "new feet." If a tenth of such "new foot" is named "new inch," a tenth part of a "new inch" being called "new line," a system would be formed, perfectly analogous to the metrical division ; to which must be added the convenience, that one would be free to choose one or the other of these measures, according to the size of the object to be measured, a convenience proved by experience. Of the multiples of the pace it would only be necessary to take the rod of the land surveyor at 5 paces, his measuring-chain at 25 paces, and, in general, the "new mile" at 1000 paces (making 125 to the centesimal degree). People will soon get accustomed to the shortness of this "new mile." Up to 1000 paces no subdivisions need be taken, nor from thence up to the greatest length, viz: the circumference of the earth = 50,000 miles. Even in France people are gradually adopting the sole use of the "kilometre," being analogous to the "new mile." With regard to the other mode of subdividing the normal pace by continuous halves, it is only the yard as a measurement of length that deserves our attention. We take the yard to be equal to one pace, dividing the same as stated above into $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, &c., dividing the other side of the measure into 100 equal parts, in order thus to pave the way to the decimal division.

The superficial measures can be very simply adapted to the new system. The general unit, viz: the square pace, with its subdivision into 100 square feet, &c., seems to meet the exigencies of arts, industry, and science; and one acre of 1000 "new square paces," would be sufficient for land surveying. Hence, a "new square mile" would contain the following, viz: $1000 \times 1000 =$ one million of square paces, or 1000 new acres, which would be the most convenient figures.

Cubic Measures.—The general unit might be the cubic pace, which would be convenient for all measurements of larger volume, and for making calculations in practical life. Its subdivision into 1000 new cubic feet, and further decimal parts, would be sufficient for the purposes of science, building, mining, the mechanical arts, commerce, and industry; and only the retail trade, in order to facilitate the application in shops and at markets, would require another division of the cubic pace, in accordance with the principle of continuous halves, because the term "half" is the most easily understood. In this instance, the different measures of capacity for measuring grain and fluids, have principally to be taken into consideration, not only in regard to the correctness of the contents, but also with reference to the convenience of their size and form for daily use.

Weights.—Here we adopt, without further hesitation, the kilogramme, according to the same principle, as laid down above, in ascertaining the measurement of lengths; we take the kilogramme as being equal to 1000 "grammes," as it is used now, and find, that $(1\ \text{m.})^3$ $(0{\cdot}8\ \text{m.})^3$ the weight of a "new cubic foot" of water, equals 1000 "grammes" $\times$ $(0{\cdot}8\ \text{m.})^3 = 512$ grammes, which we may very properly call "new pound" ("livre"); the more so, as it agrees with the old pound usual everywhere, as nearly as can be desired, in the absence of a natural relation between metre and pace.

As regards naming the subdivisions of measures and weights, it would certainly facilitate their use, if these also could be uniform among all nations, but the difficulty which the introduction of the metrical system has met with in France, compared with the much easier introduction of this system in Holland, would seem sufficiently to prove that it would be well to take the special nomenclature as much as possible from the languages themselves. In the outset, it is of paramount importance to keep intact this system, based on the innate force of simplicity and convenience, whilst the linguistical part of it may properly be left to future development, till a period when the general union of languages will have made its progress—by railroad.

It is, however, absolutely necessary, that all old and contradictory customs in reference to sizes, division of measures and weights, be entirely done away with, as otherwise neither a general agreement on these things, nor the immeasurable advantages accruing therefrom, can be thought of. Accordingly, in France, as early as 1789, a desire for equal measures and weights began to show itself, and in 1790 it was determined that the Royal Society of London, and the Paris Academy of Sciences, joined with learned men of all civilized countries, should be induced to prepare a new system of measures and weights. But the events of that time were not favorable to the execution of a plan of such magnitude. It was thought sufficient to entrust it to a committee of the most celebrated French mathematicians and physicians, but unfortunately without considering the necessity of likewise joining to such a committee proper commercial and industrial capacities, to represent the special interest of these branches, which so immediately form the cornerstone of the material well-being of nations. The measuring of degrees, interesting as it is in a scientific point of view, with which the work was commenced, would then probably not have taken place, or at least a use would have been made of it, which had the convenience of the common measuring more in view, and the metre would not have received its present unpractical length. This defect in the metre can only be done away with, by changing it into a shorter measuring unit.

In Germany, where the evil of complicated measures and weights has been greatest from times immemorial, several governments have made attempts to unravel and unite the systems, but thus far without any complete success, because, despairing in the outset of the possibility of a thorough reform being consistently carried out, people were disposed to rest satisfied with partial successes. But this will not do with measures and weights. Everything that is done in this matter must bear a character of perfection as far as it is possible, because every change that became necessary hereafter, would require new ones, and thus again tend to complicate the whole.

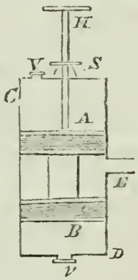
Whilst the same objections are applicable to all artificial measures, as has been proved above, and none can be recommended for general use, the exclusive application of the measure of paces, will serve infinitely to facilitate all kinds of measuring. All civilized nations concur in the opinion, that the time has arrived, when something decisive must be accomplished, and it is only to be apprehended that the impatient nations, who naturally wish soon to partake of the thing desired, might again resort to partial improvements, and thus again further remove the object of their wishes. Finally, however, though perhaps only after repeated failures, it will have to be admitted that a step backwards, to the sole use of the natural and inevitable measure which the pace suggests, will be the only means to relieve us from the obscurity of complicated measures, with their laborious reductions, mistakes, and loss of time; whilst on the other hand, it need not be apprehended that the measure of the pace, reinstated in its old rights, will ever again be superseded by a more convenient measure.

*On a New Double-acting Air-pump with a Single Clyinder.**

By T. Tate, F.R.A.S.

The chief points of novelty in this air-pump, consist in a double piston acting in a single cylinder, and in the superior system of valves. This double piston, with a single cylinder, gives to the instrument all the properties of an ordinary air-pump, with two cylinders: this new instrument, in fact, may be regarded as a single-barrelled pump, capable of performing its work with only one-half the usual motion.

The annexed diagram represents a section of the cylinder, &c., of my new air-pump: CD the cylinder; A and B solid pistons, rigidly connected by a rod, and moved by the piston-rod AH, passing through a stuffing-box S; V and *v* valves lifting outwards; R an open pipe at the middle of the cylinder leading to the receiver, from which the air is to be exhausted. The distance between the extreme faces of the pistons is about ⅜ths of an inch less than one-half the length of the cylinder, this ⅜ths of an inch being the space requisite for clearing the exhausting pipe R. The pistons are each about 1½ inch in thickness, and the rod connecting them may be of any section consistent with strength. The effective length of the stroke is equal to the space between one side of the pipe R, and the corresponding end face of the cylinder, or it is very nearly equal to one-half the length of the cylinder.



In an upward stroke, the air above the piston A, is propelled through the valve V into the atmosphere, while a vacuum is being formed beneath the piston B. When the piston A strikes against the top of the cylinder, the air from the receiver rushes through the pipe R, and diffuses itself through the lower half of the cylinder. In a downward stroke the air beneath the piston B, is propelled through the valve *v* into the atmosphere, while a vacuum is being formed above the piston A, and so on. It will be observed, that *the double piston performs a double duty at every single stroke;* for while a vacuum is being formed on one side of the cylinder by one piston, the other piston is propelling air from the opposite side of the cylinder into the atmosphere.

This pump not only exhausts the air more rapidly than the common pump, but it also carries that exhaustion to a much higher limit.

This has been fully confirmed by actual experiment. I have had a pump made on this new principle, with a stroke of 8 inches, and 1½ inch in the section,† and I have compared it with a superior pump on the old construction: the following is an exact statement of the results of my experiments.

Results of experiments with the new Pump.

Capacity of the receiver 108 cubic inches. Common siphon gauge.

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* From the Lond., Edin., and Dub. Philos. Mag., April, 1856.

†This instrument may be seen at Messrs. Murray & Heath's, Philosophical Instrument Makers, Piccadilly.

Elasticity of the air in the receiver at the end of sixty *single strokes* = ·12 inches of mercury. Limit of exhaustion = ·05 inches of mercury.

Results of experiments with a common double-barrelled Pump, EACH PISTON *having a stroke of* 4 *inches.*

Capacity of the receiver, &c., as before.

Elasticity of the air in the receiver at the end of 120 strokes of the two pistons = ·6 inches of mercury.

Limit of exhaustion = ·3 inches of mercury.

The advantages of this new pump, as compared with the common pump of the same capacity of cylinder, are as follows:—

1. To effect the same exhaustion, the driving pressure moves over one-half the space.

2. From the superior construction of valves, the exhaustion is carried to a much greater extent.

3. From having a double stroke in a single cylinder, the expense of construction is considerably reduced.

4. As the exhaustion proceeds, the pressure requisite for moving the pistons becomes less and less. The contrary takes place in the common pump.

In the pump which I have constructed the valves are made of oil-silk, and the piston-rod is moved by the direct application of the pressure; but I purpose to construct a pump on the new principle, with metal valves covered with oil-cisterns, and lifted up by the stroke of the piston, and also with a pump-lever (or crank), attached to the head of the piston-rod. The pump thus constructed will most certainly exhaust the air from the receiver, until its elasticity is reduced to that of the vapor of the oil.

Hounslow, March 20, 1856.

On Photo-galvanography; or, Engraving by Light and Electricity.[*]

HERR PAUL PRETSCH, late manager of the Imperial Printing-office, Vienna, has invented, and is now perfecting, a very remarkable method of engraving, by the combined processes of photography and electricity. The following description of his invention is from a lecture delivered by him, on the 23d ult., at the Society of Arts:

My invention consists in adapting the photographic process to the purpose of obtaining a raised or sunk design, on a glass or other suitable plate covered with glutinous substances, mixed with photographic materials, which design can then be copied by the electrotype process, so as to procure plates suitable for printing purposes. The operator first coats a glass plate with a gelatinous or glutinous solution, suitably prepared with chemical ingredients, sensitive to light, as follows:—One part of clear glue is soaked in about 10 parts of distilled water, but the quantity of water depends upon the strength of the glue, and the state of the atmosphere. Meanwhile, there are prepared three different solutions, viz: a very strong solution of bichromate of potash, a solution of nitrate

[*] From the Lond. Mech. Mag., May, 1856.

of silver, and a weak solution of iodide of potassium. The glue is dissolved by heat, and a small quantity of it is added to each of the two solutions of silver and iodide. The remaining greater portion of the glue is kept warm, the solution of bichromate of potash added, and well mixed. After which the small portion of the glue with silver is added, and also mixed well, and allowed about ten minutes time for combining. Finally, the small portion of the glue with the iodide is added, the whole mixture strained, and it is then ready to be poured on the plates of glass or other suitable material. When dry, the coated plate is ready for exposure. The photographic picture, the drawing, print, or other subject to be copied, being laid on the prepared coated surface, they are to be placed together in a photographic copying frame, and exposed to the influence of the light. After a sufficient exposure, which is exceedingly variable, according to the intensity of the light, the plate is taken out from the copying frame, when it will be found to exhibit a faint picture on the smooth surface of the sensitive coating. It is then washed with water, or a solution of borax, or carbonate of soda, as may be necessary. The whole image comes out in relief with all its details, and, when properly done, with all its brilliancy.

If the original is a protograph, chalk, sepia, or Indian ink drawing, the copy represents the different tints in grains; if in lines, the copy will reproduce the lines.

When sufficiently developed, it must be washed with spirits of wine. The surplus moisture is removed, and the plate is covered with a mixture of copal varnish, diluted with spirits of turpentine. After some time, the superfluous varnish must be removed by oil of turpentine, and the plate treated again, or immersed in a very weak solution of tannin or other astringent liquid. During this part of the process, the plate must be carefully watched, and removed as soon as the picture or design is considered sufficiently raised; it is then washed in water and dried. In this state the plate is ready to be copied. This may be effected by the customary methods of rendering the coating conducting, and placing it in the electrotype apparatus, producing an intaglio copper-plate; or, if first moulded the intaglio mould furnishes the means of obtaining a relievo plate by electro-deposition in a similar way. To produce a *sunk* design on the prepared plates, I proceed as before, but after washing with the spirits of wine, the plate must be dried on a warm place, and in due time the picture or design will appear sunk like an engraved plate. The printing plates are produced as before described.

If an intaglio plate is made, it may be printed from, at the common copper-plate printing press; on the other hand, the relievo plate may either serve as the matrix for producing an intaglio printing plate, or it may be itself employed in "surface" printing, like a wood-cut. In the latter case, the narrow lines of the impression being sufficiently raised, the broad white spaces must be cut out on the printing plate, or built up in the matrix. The common well-known stereotype process, also affords another means of producing the necessary plate.

It is well known to practical men that any impression made by fatty ink can be transferred on stone or zinc, for the purpose of printing from it in a chemical way. This method can be also used in the present process, and there are some hopes of obtaining a good impression from the first class plate, which can be transferred and printed.

After the delivery of the lecture, Mr. Roger Fenton, the recent Hon. Secretary of the Photographic Society, spoke very highly of the merits of the invention, and the progress made in the development of it during his absence in the Crimea.

Modification of Dry Collodion Process.[*]

If you deem the following modification of two dry collodion processes interesting to your readers, perhaps you will give it space in your next copy. It possesses advantages combined of the gelatine and glycerine, giving great density and definition, as will be seen by the inclosed small specimen. I prepare the plates with Ramsden's collodion in the usual manner, in a slightly acid bath; after well washing, a solution (made by dissolving 180 grains of pure gelatine in 20 oz. of water, filtering while hot, and when nearly cold adding 3 oz. of glycerine of a specific gravity 1·300,) is poured upon the plate for a few seconds, drained, and dried by the application of a gentle heat, or allowed to do so spontaneously. I have kept plates 38 days thus preserved without discovering any diminution of sensitiveness. The print inclosed is from a plate kept 20 days with 35 seconds exposure—the lens a double-quarter plate, with ½-inch stop. I immerse the plate in cold water for 5 or 10 minutes before developing, which can be done with either gallic acid and nitrate of silver, or pyro-gallic acid. Samples of gelatine differ considerably, and in some cases I advise the reduction of the quantity. This can only be determined by experiment. I am, &c.,

E. Beckingham.

100, Bath Row, Birmingham, Dec. 3, 1856.

Razors from Uchatius Steel.[†]

The Austrian correspondent of the *Times* writes, with reference to the steel produced by Capt. Uchatius's new process:—"A commtttee, appointed by the French Ministry of Commerce (as fully referred to in the *Mining Journal* of Oct. 18,) has just reported that M. Uchatius, an Austrian captain of the artillery, has at length succeeded in making good cast-steel at a low price. The assurance has been given me that the steel, which can be made harder or softer, and more or less elastic, costs from 50 to 75 per cent. less than any other steel of the same quality, and personal experience enables me to state that Uchatius steel makes excellent razors."

Aluminum[‡]

Is coming into more general use in France. The eagles which surmount the colors of the army, hitherto made of copper, gilt by galvanism, are now made in this new metal, and thus lighten the weight of the flag by nearly 2¾ lbs. Aluminum is more sonorous than bronze, and is, consequently, brought into use for musical instruments. Spoons and forks, drinking cups, &c., have also been formed of it. The weight of aluminum is only about one-fourth that of silver. Fine silver being worth 225 fr. the kilogramme, and aluminum 300 fr., a piece of the latter, equal in size to a kilogramme of silver, will be only worth 75 fr., instead of 225 fr.; thus a fork and spoon, which in silver would cost 50 fr., would be only 16 fr. in this new metal.

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[*] From the Lond. Athenæum, Dec., 1856.

[†] From the London Mining Journal, No. 1109.

[‡] From the London Mining Journal, No. 1107.

Webster's Elastic Metallic Tubes.

Mr. James Webster, of Birmingham, has patented a method of making elastic tubes suitable for effecting the junctions of pipes exposed to variable temperatures, or of pipes which are otherwise strained or required to bend, as the tube-couplings connecting locomotives with their tenders, hose for fire-engines, &c. The improved tubes are composed of brass, copper, or other metal or alloy, and in them a series of corrugations are made in planes perpendicular to the axis of the tube, to give elasticity to the tube, and permit of its flexure within certain limits. He prefers to make the corrugations as deep as is compatible with the nature of the metal or alloy of which the tube is made, and so narrow that the shoulders between the corrugations shall touch each other on slight flexure of the tube.—*Lond. Mech. Mag.*, *Nov.* 1856.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, February 19*th*, 1857.

John C. Cresson, President, in the chair.

John Agnew, Vice President.

Isaac B. Garrigues, Recording Secretary.

Letters were read from the Metropolitan Mechanics' Institute, Washington City, D. C., and referred to the Committee on Exhibitions.

Donations to the Library were received from the Royal Institution of Great Britain; The Institute of Actuaries, London; The Virginia and Tennessee Railroad Co., Lynchburgh, Va.; and from J. Ross Snowden, Esq., Fairman Rogers, Esq., and Drs. Wolcott Gibbs, Frederick A. Genth, and Thomas S. Kirkbride, Philadelphia.

Donations to the Cabinets from Judge S. Ross, Coudersport, Penna.; David Munson, Esq., Indianapolis, Indiana, and Edward Miller, Esq., St. Louis, Missouri.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer's statement of the receipts and payments for the month of January was read.

The Board of Managers and Standing Committees reported their minutes.

The Board of Managers reported that they had completed their organization by appointing the following Standing Committees for the ensuing year:—

On Publications.

John C. Cresson,
B. H. Bartol,
J. V. Merrick,
Fairman Rogers,
Washington Jones.

On Instruction.

John F. Frazer,
Frederick Fraley,
Isaac B. Garrigues,
Alan Wood,
George Erety,
Lawrence Johnson.

Managers Sinking Fund and Finance.

Samuel V. Merrick,
Frederick Fraley,
John F. Frazer,
David S. Brown,
Joseph Harrison,
Evans Rogers.

The Committee on the Library reported that during the past year there had been added to the Library—263 volumes by Purchase.
239 " " Donations.
130 " " Exchanges.

632

Making the total number in the Library January 1st, 1857, to be 6962 volumes—exclusive of newspapers, pamphlets, &c.

Candidates for membership in the Institute (4) were proposed, and the candidates proposed at the last meeting (8) were duly elected.

The Standing Committees for the ensuing year were appointed by the President, and approved as follows:—

On the Library.

John Allen,
James H. Cresson,
George Erety,
Samuel B. Finch,
Raper Hoskins,
James Lukens,
Henry K. Plumly,
James D. Rice,
Thomas S. Stewart,
Samuel S. White.

On Cabinet of Minerals and Geological Specimens.

Isaac H. Conrad,
John F. Frazer,
F. A. Genth,
B. B. Gumpert,
John L. Le Conte,
J. P. Lesley,
B. Howard Rand,
J. H. Slack,
Lawrence Turnbull,
John C. Trautwine.

On Cabinet of Arts and Manufactures.

James C. Booth,
Thomas Bickerton,
Samuel Broadbent,
William Erety,
John M. Gries,
David M. Hogan,
John T. Hammitt,
F. de B. Richards,
John Wallace,
Joseph H. Warrington.

On Cabinet of Models.

William H. Clarke,
James Dougherty,
George C. Howard,
Henry Howson,
Wm. H. Harrison,
Alfred C. Jones,
Samuel W. Leinau,
Percival Roberts,
Charles J. Shain,
Alfred Young.

On Exhibitions.

John E. Addicks,
John Agnew,
George W. Conarroe,
James H. Cresson,
Owen Evans,
Joseph Harrison,
Samuel V. Merrick,
Thomas S. Stewart,
Isaac S. Williams,
Thos. J. Weygandt.

On Meetings.

William B. Atkinson,
James Eccles,
William H. Gobrecht,
Henry Howson,
Washington Jones,
Alfred L. Kennedy,
Thomas S. Martin,
B. Howard Rand,
William B. Reaney,
Lawrence Turnbull.

On Meteorology.

Charles M. Cresson,
Owen Evans,
John F. Frazer,
James A. Kirkpatrick,
Samuel S. Garrigues,
E. Otis Kendall,
Alfred L. Kennedy,
James A. Meigs,
Fairman Rogers,
Ayres Stockly.

J. D. Rice brought, for the inspection of the members, a new design for Lightning Conductors. The conductor is formed of fluted tubes of copper, joined by screw sockets, the ends of the tubes abutting, so that the communication is complete. The top is terminated, as in the most approved plans, with a single upright platina point, surrounded by radiating pointed copper wires, set at an angle with a vertical line. The object of the corrugations is, to present a greater surface in a less diameter, and to stiffen the material; they also give the conductor an ornamental appearance, which the generality of them do not possess.

C. P. Weaver explained to the members his design for a sash fastener, consisting of a small shaft, or spindle, having a button on one end and a crank on the other; the body of the shaft passes through a cylindrical casing made in two pieces, held together by dovetails, which is intended to be fastened to the window boards in such a way, that the button end of the shaft comes next the window sash, and at right angles to it. About the middle of the shaft projects a pin, which slides in a helical slot of the casing, and which, by turning the crank one way or the other, brings the button in contact with the sash, or releases it, as may be desired.

When sashes are not counterbalanced by weights, this contrivance will serve to keep the sash at any required height; and, should they be worn, or loosely fitted, any draft may be excluded, or rattling prevented, by forcing the sash against the rebate, by the action of screw movement. All the parts are so cast as to go together, without any fitting, thus making the cost inconsiderable.

BIBLIOGRAPHICAL NOTICE.

Report of the Railroad Commissioners of the State of New York, 1856.

We have been favored by these Commissioners with a copy of their valuable Report, elucidating the working of the railroads of New York, during the year 1855.

This Report is the most able, thorough, and elaborate, document of the kind, which has yet emanated from any department of government in this country, whether state or national.

The means of producing such a work, are only to be obtained in a State, where a separate bureau is charged with procuring, filing, and analyzing, the reports of railroad companies; and such bureau must also be backed by a stringent law, (as in New York,) *compelling* the companies to answer promptly and in proper form.

Even in New York, notwithstanding this law, it appears that some of these powerful corporations, at first were contumacious, and refused to answer. But the Railroad Commissioners with a degree of promptitude and firmness which does them credit, at once referred the matter under the law, to the Attorney General, who speedily brought these recusants to answer.

Such laws ought to prevail in all our States; for this railroad interest now forms by far the most powerful body of associated capital in this country, and should be kept in strict subjection to the people, by the legislatures of the several States.

Recurring now to the Report in question, the Railroad Commissioners give us first an excellent map of the State of New York, with all the railroads marked thereon, in different colors, whether in operation, under construction, or projected.

Then they give us a copious index, and an excellent essay on railroads in general, comprising 69 octavo pages.

Then follows a series of tables spread over 183 pages, and comprising the Reports of the various railroad companies upon their financial position and operation in 1855, there being in all 55 railroads, including five city passenger railways.

These tabulated Reports in extraordinary detail, give us for each railroad, the characteristics, cost of construction, amount of stock and debts, cost of equipment, cost of working, the earnings of the year, &c. &c.; forming a vast body of valuable items of railroad statistics, which we have not room even to name.

Then follows 112 pages of tabular deductions, giving the most minute details of the expenses and receipts of railroads.

Then we have the Reports of an Engineer (James Laurie, Esq., C. E.) specially charged to examine some suspicious bridges upon various of the railroads. These cover 25 pages, and are very lucid and satisfactory.

Then follows a synopsis of the Reports of the New York Railroad companies, from 1833 to 1855, covering 20 pages; and then comes an analysis of all the accidents resulting in the wounds or death of people.

The letter press terminates with an Appendix, containing a valuable codification of running rules, special inquiries into certain accidents, &c., and the Report is fitly concluded by engravings of full sized cross sections of 74 different patterns of iron rails, used upon the various railways, and these are followed by 17 plates, showing minutely the grade profiles of the leading railroads, and also a small map of the cities of New York and Brooklyn, exhibiting the routes of the city passenger railways.

This brief notice will indicate the elaborate and valuable character of the Report in question, which forms in all an octavo volume of nearly a thousand pages, and, in our opinion, does the highest credit to John T. Clark, William J. McAlpine, and James B. Swain, Esqrs., the Railroad Commissioners of New York, while it cannot fail to be of great service, not only to the people of that state but to our country generally.

Though our space will not at present admit of very copious extracts from this important Report, we cannot refrain from making a few.

It appears that the railroads of New York, are 2616 miles in length, and cost $132,753,104, or rather over an average of $50,000 per mile, which includes equipment.

Of the *narrow* gauge, $4\frac{7}{10}$ths feet, are 1635 miles, and of the *broad* gauge, 6 feet, are 981 miles.

A traveler journeying over all the railroads of New York, would therefore travel 2616 miles, ascend 14,707 feet, descend 17,588 feet, and pass around curves exceeding 140 full circles, or turn round and round that many times in traversing the 50,000 degrees of curvature reported. He would cross 1320 bridges of wood and iron, in all 178,423 feet long, pass over 4361 culverts, and by 8731 road crossings, of which 7649 are level with grade. He would cross 2282 switches, 837 of which have no permanent tenders. He would, or might, see 735 locomotives, and 11,063 cars of various kinds. He would find that in 1855, these railroads moved 471,644,264 passengers *one mile*, and in doing so moved with them 536,244,073 tons of *non-paying* weight one mile, or $1\frac{17}{100}$th tons of dead weight for every passenger carried! Also, that in the same year, 346,217,614 tons of freight were moved *one mile;* and that to effect this, 822,829,025 tons of *non-paying* load was drawn *one mile*, so that for every ton of paying freight, they hauled $2\frac{3}{4}$ tons of dead weight!

In 1855, the earnings of the 55 railroads were = $19,597,009
" the expenses " (58 per cent.) = 11,284,565

Net earnings, . . $8,312,444

Per Mile Run by Trains, the Expenses were in cents.

	Passenger Transportation.	Freight Transportation.	Both.
For maintenance of road,	= 22	24	23
" machinery,	= 17	20	18
" operating expenses,	= 48	69	58
Totals,	= 87	113	99

It is remarkable that the average cost of running *a train one mile*, on these roads in 1855, making no distinction between passengers and freight, was 99 cents per mile run. Now, many years ago, in the infancy of our system, when the Chevalier De Gerstner investigated the Railways of the United States, he found upon a similar general average, the expense of running a train one mile, *was one dollar;* so that notwithstanding constant improvements in machinery and more extensive experience, we do not seem to have reduced the cost per mile of running trains. But the trains of the present day have doubtless a larger business capacity, and therefore, in effect, a greater economy.

The average cost of maintenance of way, including repairs of iron, averaged $1005 per mile of railroad.

The average number of passengers per train was 72, and per car 16 passengers, while the average distance traveled by each, was 45 miles only.

The average number of tons of freight per train was 71, and per car 4 tons, while the average distance carried, was 102 miles.

The per centage of the number of all passengers, shows the singular result on these railroads, of only 18 per cent. *through*, and 82 per cent. *way!*

This shows the superior importance to railroads of the *local* business, about which little is said, over the through business, which forms the chief burden of railway notices and advertisments.

Of all the freight, the per centage *through* was 48, and *way* 52.

	Per Cent.
The per centage of Freight *towards* tide-water,	=62·
" " *from* "	=38·
	100·

Gross Receipts per mile of Railroad,	= $7569 for 1855.
Expenses " " (58 per cent.)	= 4284 "
Net earnings, (42 per cent.)	$3285

Average cost of Locomotive Engines,	= $9625·
" Passenger and Baggage Cars,	= 2011·
" Freight Cars,	= 632·

Other very valuable generalizations follow, showing the origin of the masses of material which constitute *freight* and the direction taken by the bodies of people who form *passengers;* but these we have only space to note in passing: like the other deductions of this Report, they well deserve the attention of railroad men.

The average cost for each Passenger and each ton of Freight carried one mile, was, in decimals of a cent, as follows:—

	Passenger.	Freight.	Both.
For maintenance of road,	= ·290	·343	·339
" of machinery,	= ·233	·285	·249
" operating expenses,	= ·670	·970	·810
Totals,	1·193	1·598	1·398

By a somewhat different train of averages, the following results were obtained:—

	Passenger.	Freight.	Both.
Earnings per mile run by trains	= $1·45	$2·03	$1·76
Expenses " "	= 0·84	1·09	1·00
Net profit,	$0 61	$0·94	$0·76

And per passenger, and per ton of freight, the general results were:

	Passenger.	Freight.	Both.
Earnings per pass. and per ton, one mile	= 2·01 cents	2·80 cents	2·40 cents
Expenses " " "	= 1·10 "	1·50 "	1·30 "
Net profit,	0 91 "	1·30 "	1·10 "

Pages 272 and 295 of the Report under consideration, show but too clearly, that the Railroads of New York, taken as a whole, are not earning seven per cent. interest upon their total cost, and that in order to do so upon their present business, their charges on all items would have to be materially increased; and this is not the experience of New York only; throughout our country we regret to note, that the great benefits conferred by railroads, do not appear as a general thing, to have resulted in profit to the enterprising men who built them. E. M.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

APRIL, 1857.

CIVIL ENGINEERING.

The Mountain Top Track:—A Description of the Railroad across the Blue Ridge at Rock Fish Gap, in the State of Virginia. By Charles Ellet, Jr., Civ. Eng.

Mr. Charles Ellet, Jr., has always been distinguished among his professional brethren in this country, for the boldness of his engineering conceptions, and the assiduity and perseverance with which he devotes himself to the accomplishment of his projects. Enjoying the advantage also of regarding himself and his labors in the third person, (objectively as our German friends have it,) he has no hesitation in saying what he thinks of them, frankly and boldly, and as this is all necessarily in their favor, they are never wanting in at least one competent defender.

The pamphlet before us contains the account of the accomplishment of one of these schemes of Mr. Ellet, a project for the construction and regular working by locomotives of a railroad of steep gradients and abrupt curves, a project which seems to have met the opposition of some of the more timid of his professional brethren, while the simplicity of its principles, and apparent complete success, seem likely to condemn the originator to receive far less approbation than he really deserves for the successful introduction of such a novelty. Whether it is strictly true that "the difficulties overcome in the location and working of the line, very much exceed those which have made the Austrian road over the Sœmmering, famous throughout Europe," we cannot affirm, without better means of examination than are in our possession, and whether the achievement is to be set in history alongside of the conception and execution of the road over the Simplon, posterity must decide, but it appears to us undeniable that it is at least deserving of being known out of the State of Virginia, and a knowledge of its success may, perhaps, encourage others in combating in other cases, the prejudices and misapprehensions which so frequently oppose improvement.

The Mountain Top Track is a part of a continuous line of railroad in course of construction through Central Virginia, from Richmond to the Ohio; and it appears that the Commonwealth of Virginia undertook the construction of 17 miles of this route, embracing the passage of the Blue Ridge, and the tunnel which was supposed necessary for this passage. As usual, the Commonwealth, like all other similar bodies, found it impossible to do what appeared so easy to be done, and finding, after four years' work on the tunnel, that at least three years more would be necessary for its completion, and that in the meantime, the Company of which he was the engineer, could not enjoy the revenue of the capital expended in the incomplete works, Mr. Ellet formed the bold design of crossing the Ridge by a temporary track to be worked by locomotive power, and intended to maintain a complete connexion of the roads at the eastern and western base. The description of this route, the degree of success which it has attained, and the means by which this has been secured, we extract from Mr. Ellet's pamphlet, congratulating him on an achievement, which must add still more reputation to that which he has heretofore earned. It may be as well also to note as a remembrance, that this idea of constructing a locomotive to work upon steep gradients, is, we believe, due to Mr. William Norris, of this city, and that the engines constructed by him in 1836, which frequently did service on the inclined plane at the Schuylkill, when the rope of the stationary engine was broken, were the first engines constructed which were capable of this kind of work.

Description of the Road.

The Mountain Top Track crosses the summit of the Blue Ridge at Rock Fish Gap, where the elevation of the mountain is 1885 feet above tide. The crest of the ridge is very narrow, and is passed on a curve of 300 feet radius.

There is barely room for an engine with an ordinary train to stand on the summit, before the road slopes off, descending both towards the east and west, to the valleys on either side of the ridge.

Western Side.—The length of the descent on the western side, from the summit to what is here assumed to be the foot of the mountain, is 10,650 feet, or $2\frac{2}{100}$ miles.

The track descends in this distance, on the west side, 450 feet—or, at the average rate of one foot in $23\frac{2}{3}$ feet.

The *average grade* on the western slope is, therefore, $223\frac{1}{10}$ feet per mile.

The *maximum grade* on the western slope is $5\frac{3}{10}$ feet in 100, or $279\frac{84}{100}$ feet per mile.

On both sides of the mountain the ruling curves are described with a radius of 300 feet, on which the grade is $237\frac{6}{10}$ feet per mile.

The excess of the maximum over the average grade is occasioned by the attempt to compensate, in the distribution of the necessary ascent, for the effect of curvature. There was no experience to guide the writer in the arithmetical determination of the influence of such curvature as it was necessary to introduce upon this road, and the proper diminution of the slope required on the curves to compensate for the increased traction which would there be due to the curves. On this point professional information is still very deficient, even for curves of ordinary radii, traversed by engines of common construction propelled at the usual velocities of freight or passenger trains. For such an anomalous line as the writer was about to construct, there was absolutely no guide; and his allowance was therefore almost entirely conjectural.

When the road was first opened, it speedily appeared that the difference of 43 feet on the western side, and 58 feet on the eastern side, between the grades on curves of 300 feet radii and those on straight lines, was not sufficient to compensate for the increased traction due to such curvature. The velocity, with a constant supply of steam, was promptly retarded on passing from a straight line to a curve, and promptly accelerated again on passing from the curve to the straight line.

But, after a little experience in the working of the road, it was found advisable to supply a small amount of grease to the flanch of the engine by means of a sponge, saturated with oil, which, when needed, is kept in contact with the wheel by a spring. Since the use of the oil was introduced the difficulty of turning the curves has been so far diminished that it is no longer possible to determine whether grades of $237\frac{6}{10}$ feet per mile on curves of 300 feet radius, or grades of 296 feet per mile on straight lines, are traversed most rapidly by the engine.

Eastern Side.—But the more difficult portion of the work was on the eastern side of the mountain, where the ascent was greater, and the slope, in order to reach a certain level, which became a necessary condition of the problem of location, was required to be greater.

The length of the line of descent from the summit to the foot of the grade, is 12,500 feet, or $2\frac{37}{100}$ miles.

The road descends in this distance 610 feet, or at the average rate of one foot in $20\frac{1}{2}$ feet.

The *average grade* on the eastern slope is, therefore, $257\frac{4}{10}$ feet per mile.

The *maximum grade* on the eastern slope is $5\frac{6}{10}$ feet in 100, or $295\frac{68}{100}$ feet per mile.

This maximum grade is found in a continuous line of half a mile in length.

The shortest radius of curvature on this side of the mountain was intended to be 300 feet; but in the construction of the work a more abrupt curve was introduced at one difficult point, in order to throw the track further into the hill and keep the embankment off a face of sloping and treacherous rock. At this ravine, which is found about half way down the mountain, the radius of curvature is only 231 feet, and the grade upon that curve is $237\frac{6}{10}$ feet per mile.

The total length of the track from the foot of the mountain on the west side, across the summit, to the foot of the mountain on the east side, is

$4\frac{30}{100}$ miles. But, in consequence of delays which occurred in the construction of other parts of the Commonwealth's road, it became necessary to extend the track $3\frac{1}{2}$ miles further, running it around unfinished cuts and embankments at four different points, so that the distance actually worked by the mountain engines is about *eight miles.*

The Locomotive Engines used.

This road was opened to the public in the spring of 1854, and it has now, in the autumn of 1856, been in constant use for a period of more than $2\frac{1}{2}$ years. In all that time the admirable engines relied on to perform the extraordinary duties imposed upon them in the passage of this summit, have failed *but once* to make their regular trips. The mountain has been covered with deep snows for weeks in succession, and the cuts have been frequently filled for long periods many feet in depth with drifted snow: the ground has been covered with sleet and ice, and every impediment due to bad weather and inclement seasons has been encountered and successfully surmounted in working the track.

During the last severe winter, when the travel upon all the railways of Virginia and the Northern and Western States was interrupted, and, on many lines, for days in succession, the engines upon this mountain track, with the exception of the single day already specified, moved regularly forward and did their appointed work. In fact, during the space of $2\frac{1}{2}$ years that the road has been in use, they have only failed to take the mail through in this single instance, when the train was caught in a snow drift near the summit of the mountain.

These results are due, in a great degree, certainly, to the admirable adaptation of the engines employed to the service to be performed; but they are due, also, in no small degree, to the skill and energy of the superintendent in immediate charge of the track and machinery.

The locomotives mainly relied on for this severe duty were designed and constructed by the firm of M. W. Baldwin and Company of Philadelphia. The slight modifications introduced at the instance of the writer to adapt them better to the particular service to be performed in crossing the Blue Ridge, did not touch the working proportions or principle of the engines, the merits of which are due to the patentee, M. W. Baldwin, Esq.

These engines are mounted on six wheels, all of which are drivers, and coupled, and 42 inches in diameter. The wheels are set very close, so that the distance between the extreme points of contact of the wheels and the rail, of the front and rear drivers, is 9 feet 4 inches. This closeness of the wheels, of course, greatly reduces the difficulty of turning the short curves of the road.

The diameter of the cylinders is $16\frac{1}{2}$ inches; and the length of the stroke 20 inches.

To increase the adhesion, and at the same time avoid the resistance of a tender, the engine carries its tank upon the boiler, and the footboard is lengthened out and provided with suspended side boxes, where a supply of fuel may be stored. By this means the weight of wood and water, instead of abstracting from the effective power of the engine, contributes to its adhesion and consequent ability to climb the mountain.

The total weight of these engines is 55,000 pounds, or 27½ tons, when the boiler and tank are supplied with water and fuel enough for a trip of eight miles is on board.

The capacity of the tank is sufficient to hold 100 cubic feet of water, and it has storage room on top for 100 cubic feet of wood, in addition to what may be carried in the side boxes and on the footboard.

To enable the engines better to adapt themselves to the flexures of the road, the front and middle pair of drivers are held in position by wrought iron beams, having cylindrical boxes in each end for the journal bearings, which beams vibrate on spherical pins fixed in the frame of the engine on each side and resting on the centres of the beams. The object of this arrangement is to form a truck, somewhat flexible, which enables the drivers more readily to traverse the curves of the road.

There were three engines constructed expressly for this track, of which two answer to the description here given. The third engine was built by Mr. Joseph R. Anderson, of Richmond, and is an excellent machine and capable of doing good service. Resting on eight wheels, and being more rigid than the others, it does not yield so easily to the very short curves of this track. It is therefore kept on hand as a reserve engine, and is frequently employed to relieve the regular engines of the road.

Duties and Speed of the Engines.—The writer has never permitted the power of the engines on this mountain road to be fully tested. The object has been to work the line regularly, economically, and, above all, *safely;* and these conditions are incompatible with experimental loads subjecting the machinery to severe strains. The regular daily service of each of the engines is to make four trips, of eight miles, over the mountain, drawing one eight-wheel baggage car, together with two eight-wheel passenger cars, in each direction.

In conveying freight, the regular train on the mountain is three of the eight-wheel house cars fully loaded, or four of them when empty or partly loaded.

These three cars, when full, weigh with their loads from 40 to 43 tons. Sometimes, though rarely, when the business has been unusually heavy, the loads have exceeded 50 tons.

With such trains the engines are stopped on the track, ascending or descending, and are started again, on the steepest grades, at the discretion of the engineer.

Water, for the supply of the engines, has been found difficult to obtain on the mountain; and since the road was constructed a tank has been established on the eastern slope, where the ascending engines stop daily on a grade of 280 feet per mile, and are there held by the brakes while the tank is being filled, and started again at the signal and without any difficulty.

The ordinary speed of the engines, when loaded, is 7½ miles an hour on the ascending grades, and from 5½ to 6 miles an hour on the descent.

Greater speed and larger loads might doubtless be permitted with success; but the policy has been to work the track with perfect safety, to risk nothing, and to obtain and hold the public confidence.

Brakes, *Couplings*, *&c.*—In recommending the use of this anomalous track for the conveyance of passengers, the writer felt severely the great responsibility of his position. No care that his judgment and foresight could provide was neglected to secure the most perfect safety to those whose lives were entrusted in the hands of the Company and its agents.

The rule was adopted that no car should be suffered to cross the mountain that did not possess a brake for every wheel, of power sufficient to clutch the wheel firmly and prevent its rotation. All fixtures by which the brakes might be acted upon by the engineer, and the power conveyed simultaneously to all the wheels through a common bar or chain, were rejected, because the giving way of this connecting bar would render all the brakes which were made dependent upon it powerless.

The brakes were required to be inspected at every trip by an experienced man, and to be in perfect order for service before the mountain engine could be attached to the train.

The giving away of a coupling was another source of danger to be guarded against upon such grades; for, if the brakemen on the ascending train should be neglectful, and fail to apply their brakes when a coupling bar or bolt should break, the disengaged car might be carried down the grade.

To guard against this danger, reliable couplings were provided for all the cars; and, for further security against the possibility of such an accident, two powerful tug chains were attached as extra couplings between the locomotive and the forward car, and also between each two separate cars, which are reserved couplings, coming into service only in case the regular coupling bar or its connexions should part. These guard chains are always attached as soon as the mountain engines, or "climbers," as they are called, are put on.

When the track is in good condition, the brakes of only two of the cars possess sufficient power to control and regulate the movement of the train—that is to say, they will hold back the two cars and the engine. When there are three or more cars in the train, the brakes on the cars, of course, command the train so much the more easily.

But the safety of the train is not dependent on the brakes of the cars. There is also a valve or air-cock in the steam chest, under the control of the engineer. This air-cock forms an independent brake, exclusively at the command of the engineer, and which can always be applied when the engine itself is in working order. The action of this power may be made ever so gradual, either slightly relieving the duty of the brakes on the cars, or bringing into play the entire power of the engine.

The train is thus held in complete command. Yet no precaution is neglected to have all parts of the machinery always in effective condition—brakes, each and all—in perfect order, every man at his post, and a competent and vigilant superintendent over them to enforce discipline and command the train.

A supply of sand is not neglected; for, though the brakes completely control the train in ordinary weather, yet, when the cold is intense, and the track, wheels, and brakes are all covered with snow, frozen into hard ice, they will not hold. Then, as usual, sand is applied in the front of the forward drivers or in front of the middle drivers, as is, under the circumstances, most expedient; and the friction may be increased to whatever amount is necessary for the safety of the train.

With the passenger trains, there is a man at the brake on every platform, who never leaves his post while on the mountain, whether the train be ascending or descending. For the freight trains, four brakemen are required to attend to the brakes of three cars, or five brakemen to those of four cars.

Such tracks as this over the Blue Ridge are very dangerous under negligent or unskilful management. But with care to observe the rules prescribed, and to keep within the authorized loads and speed, they are quite as safe as, if they are not safer than, ordinary railways worked with ordinary care.

Current Expenses of this Track.

The current expenses of maintaining and working this track are scarcely as great as might be expected from its anomalous and difficult character.

The ordinary consumption of fuel by one of the mountain engines, ascending the eastern slope of the mountain, from the foot of Robinson's Hollow to the summit—a distance of $2\frac{62}{100}$ miles—in which an elevation of 660 feet is overcome, and many curves of 300 feet radius are turned, is 42 cubic feet, or very nearly one-third of a cord. The total weight of the engine and train, or mass moved, is 70 tons.

The cost of fuel is there $2·00 a cord.

The fuel used in traversing the whole length of the track, from the Greenwood Station to the western base of the mountain, a distance of 8 miles, including both the ascent and descent of the mountain, is two-thirds of a cord, costing $1·33, exclusive of the cost of firing up.

The total cost of working the two engines when making two round trips each per diem, is as follows:—

2 Engineers, at	$75	each per month,	$ 150·00
6 Brakemen, "	20	" "	120·00
2 " "	25	" "	50·00
2 Firemen, "	25	" "	50·00
2 " "	17·50	" "	35·00
1 Machinist, "	75	" "	75·00
Wages of engine and train hands, per month,			$ 480·00
Fuel, oil, &c., for two engines, per month, when making each four trips a day,			350·00
			$830·00

Annual locomotive expenses, $9960.

Maintenance of the Road.

Salary of Superintendent, per annum,	$ 1,200·00
2 Section Masters, each $400,	800·00
12 Laborers (negroes), at $ 150 per annum,	1800·00
1 Laborer at wood station,	150·00
Amount carried forward,	$ 3950·00

Amount brought forward,	$3950·00
2 Watchmen at trestles, $ 240,	480·00
1 Night Watch at terminus,	365·00
Annual Cost of Superintendence and Maintenance,	4795·00
Add Locomotive expenses,	9960·00
Cost of Maintaining and Working,	$ 14,755·00
or, per mile per annum, $1845.	

To this total must be added, of course, the cost of repairing the locomotive engines and cars; and also the depreciation, properly due to this track, of the cars and engines and the track itself.

The engines, when delivered to the Company, were all exceedingly substantial, and have needed but small current repairs beyond what the machinist of the track has been able to give to them and to the cars. No separate account has been or could be kept of the other repairs of the cars—the track being worked in connexion with the road east and west of the mountain.

Depreciation is always a very important item of railroad charges; but, while the machinery and track are comparatively new, any estimate of that item which might be here offered would be altogether speculative—while the object of this paper is to present only ascertained and reliable facts.

The writer does not wish to close this brief description of a road, which, though built for a temporary purpose only, he thinks is likely to exercise a material influence on many future works, without duly acknowledging his obligation to those gentlemen whose co-operation materially aided in the rapid progress and great success of the work.

To his principal assistant, Thomas S. Isaac, he is indebted for the skilful and accurate executions of his plans:

To C. R. Mason and Wm. S. Carter, contractors, for their great energy and obliging promptitude in providing and applying their forces wherever needed to press forward the work:

To Messrs. M. W. Baldwin & Co., of Philadelphia, for the excellent engines that work the road: and, finally,

To George S. Netherland, superintendent of this track and machinery, for his prudence, carefulness and indefatigable and intelligent personal attention to the maintenance of the way and the management of the transportation across the mountain.

*On the Geology and Physical Geography of North America.** By Prof. Henry D. Rogers, from the United States.

The speaker stated that his object in this discourse was to present a condensed view of the physical features and geological outlines of North America,—a country highly interesting, from the majestic scale of its natural structure—from its peculiar position on the earth's surface, lying intermediate between Europe on the one hand, and Asia and Australia on the other—as a half-way house to connect the commerce and civilization of the world; and tenanted by an energetic people, essentially a composite nation, made up of the enterprising and ardent spirits who have gone from the various more civilized countries of Europe.

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* Notices of the Meetings of the Royal Institution of Great Britain, Feb. 8th, 1856.

Taking a comprehensive but rapid survey of the general physical features of North America, we find it presents but two great slopes, one sinking towards the Atlantic, the other towards the Pacific, divided by a lofty mountain axis, the Chippewayan or Rocky Mountain chain, the true water-shed or backbone of the continent.

From either base of this chain, where the plane of the country has an elevation of 5000 to 6000 feet above the sea, the continent slopes eastward and westward, interrupted by only two important intervening mountain swells—the Atlantic or Appalachian chain, and the Pacific or Californian. These oceanic chains only partially turn the drainage; some of the largest rivers, the Susquehanna and Kanawha, in the one case, Frazer's River and the Great Columbia in the other, cutting quite through them. Another broad swell of the surface crosses the continent, nearly westward, from Labrador to the sources of the Columbia, passing between the Lawrentian Lakes and Hudson's Bay, and between the sources of the Missouri and those of the Saskatchawan. From this the continent slopes gently northwards, to its Arctic shores, and southwards, to its Mexican. All these slopes are well indicated in the river drainage.

Looking closer, there appear seven grand primary divisions of the surface of the continent, comprising two broad continental plains, three great belts of mountains, and two narrow oceanic slopes.

A.—The largest of these areas is the GREAT CENTRAL PLAIN, extending from the Gulf of Mexico to the Arctic Sea and Hudson's Bay, and from the Appalachians to the Rocky Mountains, a wide continental region of table-lands, plains, and gentle slopes.

It consists of two physically different districts—the one a western region of elevated table-lands or steppes; the other, a parallel eastern zone of less average elevation, comprising three great basins or plains, of river and lacustrine drainage.

I. *The Western Steppes.*—These constitute a wide zone, east of the Rocky Mountains, about 350 miles broad, ranging from the 28th to beyond the 60th degree of latitude; including, indeed, the Arctic Highlands, east of Mackenzie River. From the Arkansas to the Upper Missouri this plateau has a mean level above the sea of about 4000 feet, rising, at the base of the mountains, to 5000, and at the highest east and west swell of the surface, to 6000 feet. The general eastern boundary of this great terrace, which has a mean height of about 2000 feet, follows approximately the meridian of 98° W.; but northward of the Nebraska and Missouri, it is not so well defined. Rising to the foot of the Rocky Mountains, by successive steps and gentle slopes, the plain contains one escarpment, which being much more conspicuous than the rest, seems to divide it into two belts. This, which coincides with the meridian of 101° W., is best marked between lat. 32° and the Arkansas, but extends to the Forks of the Nebraska, and yet further. From the Pecos to the Nebraska, the upper plateau is about 3500 feet above the sea, and is 1000 feet higher than the table-land east of it. This entire western belt, as far north as the Missouri, is a barren and thirsty treeless desert, especially in its southern half. It is without verdure, except along the very attenuated streams, and at certain seasons is entirely rainless. North of the Missouri it is better irrigated, and more grassy, and includes many rivers and lakes.

The lower terrace resembles the upper in its flat monotonous surface, its treeless wastes, and arid summer climates, but it is rather more grassy, and its southern streams are better fringed with trees and verdure. All the rivers, from the Pecos to the Arkansas, issue from the upper table land to the lower, through deep narrow sluices (cañons), between precipices of enormous height. For more than 400 miles, from the Brazos to the Arkansas, the lower treeless plain is fringed by a remarkable belt of woodland, from 5 to 25 miles wide, which is called the "Cross Timbers." This strip of forest forms the western boundary of the fertile and better watered still lower plain of Texas, a region of verdant prairies, dotted with natural parks, and clumps of live oaks and other noble trees.

II. *The Eastern Basins.*—This vast tract, embraced between the north-west base of the Appalachian mountains and the eastern border of the elevated western plateau, is a broad well-watered plain, full of streams and lakes, rising nowhere higher than 1500 feet above the sea; and in few districts higher than 500 to 700 feet. It includes three large natural basins of drainage—that of the Mississippi, and its affluents east of the high western steppes; that of the Lawrentain Lakes and their feeders: and that of the southern, western, and eastern tributaries of Hudson Bay.

1. *The Mississippi Basin.*—This wide river basin slopes so gently southward that its height at the mouth of the Missouri, nearly 700 miles from the sea, is only 388 feet; and at the Falls of St. Anthony, 1150 miles from the sea, it is no more than 856 feet. Its eastern and western slopes are likewise extremely gentle, as shown by the fact, that the elevation of the plain at Pittsburgh, nearly 600 miles from this Mississippi, eastward, is only 679 feet; and in the opposite direction, at the mouth of the republican fork of the Kansas, it is still but 927 feet. The basin of the Mississippi and Missouri is divided from that of Hudson Bay,—from the western end of Lake Superior to the foot of the Rocky Mountains, but eastward from the drainage of the Lawrentian Lakes, by a low water-shed, nowhere higher than 1300 feet, and in few districts more than 1000 feet above the sea. This whole Mississippi plain enjoys a soil and climate of rare fertility, and possessing enormous coal-fields and other mineral wealth, is endowed with extraordinary agricultural, commercial, and manufacturing resources. From the western slopes of the Appalachians to the Mississippi, the Wabash, and Lake Michigan, nearly the entire surface was originally clothed with forest; but west of those limits, the vast plain consists of gently rolling verdant prairies, intersected by strips of woodland along the valleys of the streams; and on the south-west, sprinkled with parks, and scattered clumps of trees.

2. *The Lawrentian Lake Basin.*—This middle basin, from the head of Lake Superior to Lake Ontario and the Ottawa, is separated on its south from the basin of the Mississippi and Ohio, by the low water-shed

bordering its lakes; and on the north, from the southern feeders of Hudson Bay, by a somewhat higher water-shed, ranging from Missabay Heights, where the summit tract is about 1500 feet high, north of Lake Superior and the Ottawa, and gradually declining to the sources of the Saguenay. It is a curious feature of this basin, that its western rim is only 50 miles west of the head of Lake Superior, the southern and northern water-sheds which embrace it, uniting in about long. 92° 50′. An unusual portion of the surface of this basin is covered with water. Its five great lakes contrast their magnitude with the smallness of the area which supplies them; for both the water-sheds are in relatively close proximity to these basins. In some districts the southern water-shed is only a few miles distant from Lakes Michigan and Erie; while some of the streams descending southward are more than 2000 miles from the Gulf of Mexico. But this anomaly vanishes, when we recognise in these lakes only expansions of the Upper St. Lawrence, their southern water-shed then taking its true half-way position below the Gulf of St Lawrence and the Gulf of Mexico. The basin of the five lakes is a wide level plateau falling eastward, by successive stages, from a level at the surface of Lake Superior of 628 feet, to one of 232 feet at the surface of Lake Ontario. Its confining water-sheds are only the eastern extensions of the great central swell of the Continent, forking where it approaches Lake Superior; one branch ranging northward, the other southward, of this long and narrow basin.

3. *The Hudson Bay Basin.*—This almost rivals in size that of the Mississippi. It is separated from that of the St. Lawrence by a low crescent-shaped, curving water-shed, beginning in the highlands of Labrador and the Watchish Mountains, and extending westward to the Missabay Heights. To the south-west and west, its boundary is the vaguely-traced limit of the western plateau, prolonged north-north-west, from the Missouri towards Lake Athabaska. This great basin is a region of innumerable tortuous streams and inosculating lakes and swamps, converging their drainage into Hudson Bay. In the northern half of the continent, the larger rivers which enter Hudson Bay, as the great Saskatchawan, descend from the base of the Rocky Mountains, across the low water-shed, which forms the western rim of this basin; thus linking it hydrographically with the high western plateau, and establishing in a wider sense, one great hydrographic basin from the Watchish to the Rocky Mountains, north of the east and west swell of the continent. The general elevation of the extensive rim of the Hudson Bay Basin, is scarcely anywhere higher than 1600 feet above the sea; the average level of the whole girdle probably not exceeding 1000 feet. It is a cold, inhospitable, and snowy district, its rocks deeply overlaid with sterile drift, and its surface extensively covered with a net-work of waters and wet swamps.

B. The Appalachian Mountain Zone.

This Atlantic mountain range embraces the whole belt of mountain ranges, extending from the Gulf of St. Lawrence at Gaspé, to Georgia and Northern Alabama. It consists of two divisions—a north-eastern, ranging from Gaspé to the valley of the Hudson; and a south-western, thence to the interior of Alabama: the total length of the chain is about 1500 miles, while its breadth varies from 150 to 200 miles. In the chief divisions of its length it is a wide complex belt of many parallel ridges, whose crests nowhere ascend much beyond 4000 feet above the sea; the base of the chain, where highest, being about 1800 feet above the sea level. From Alabama to the Hudson, the Appalachian chain is the water-shed between the Atlantic rivers and those of the Ohio and Lake Ontario; and from the Hudson to the Gulf of St. Lawrence it separates the drainage of those flowing to the Atlantic from the shorter streams entering the St. Lawrence. The Hudson valley does not entirely separate this long, nearly continuous mountain system. A depression of the continent to a depth of only 300 feet, would let the ocean through from the Gulf of St. Lawrence to the Bay of New York, and interpose a strait, nearly as broad as that between England and the European continent, between the main land of North America, and the even now half insulated districts of New England, New Brunswick, and Nova Scotia. That this great transverse depression of the surface, now uniting the estuaries of the St. Lawrence and the Hudson, was once thus actually submerged, is proved by indisputable geological monuments, consisting of oceanic clays containing marine pleistocene tertiary fossils.

The *North-eastern* section of the Appalachians contains as its principal chain the Green Mountains, a long belt of parallel and swelling ridges commencing in the Nôtre Dame range, south of the St. Lawrence, in Lower Canada, and terminating at the Schuylkill River, in Pennsylvania. These mountains at the Hudson, under the name of the Highlands, are cut to their base by that tidal river. In Vermont their rounded summits are 4000 feet high, but on the Hudson they nowhere exceed 1600 feet. The White Mountains of New Hampshire, and the Adirondac group in the north-east corner of New York, are lofty, outlaying masses, subsidiary to the Appalachians. They consist chiefly of the crystalline rocks. Their highest peaks exceed 5000 feet, and that of Mount Washington, the loftiest east of the Rocky Mountains, is 6428 feet above the sea level.

South-western Appalachians.—From the Hudson and Mohawk to middle Alabama, extends the other great division of the Appalachian chain, marked by an extraordinary parallelism, length, narrowness, steepness, and evenness of its numerous ridges. Its south-eastern belt, the most undulating and picturesque, is the Blue Ridge of Virginia, and the Smoky or Unaka Mountain range of Carolinas, Georgia, and Tennessee; it is nearly identical in geological structure with the Green Mountains, and resembles them in contour and scenery. Its highest crests, which are in North Carolina and Tennessee, reach to 4000 and 5000 feet above the sea. The rocks of the Blue Ridge and Green Mountain chains, are chiefly ancient metamorphic strata, as gneiss, talcoze, and chloritic schists and highly altered argillaceous and sandy strata low in the palæozoic system, including, indeed, some of the oldest fossiliferous formations: these stratified masses are penetrated by igneous veins and dykes.

To the north-west of the Blue Ridge, and separated from it by a long continuous plain, called the Great Appalachian Valley, runs a parallel range of the middle Appalachian belt, traceable from the St. Lawrence to Alabama. This central zone of mountains consists of long narrow level ridges, divided by narrow longitudinal valleys, and cut to their bases by sharp deep ravines permitting the passage of the rivers. These ridges, caused by excessive erosion of the parallel waves of the strata, of which the central Appalachians consist, are linked into groups of several parallel crests, some of them remarkably straight for great distances, others gently curving. In many instances two narrow mountain crests unite at the two extremities to enclose a deep trough-shaped valley; some of these valleys, with their mountain borders, having a remarkable resemblance to a long narrow canoe or skiff. One class have a synclinal structure, the highest strata being in the bed or centre of the valley, and the hard lower rocks forming the enclosing parallel mountain crest. The other class are anticlinal in their form, a powerful erosive action of waters having carved them out by cutting through the crests of the original crust-waves, and scooping down to the softer lower strata. In some portions of this middle belt the long narrow ridges unite in wider mountain table lands of the general height of the chain.

The rocks of this long middle Appalachian belt are exclusively palæozoic strata, comprising all from the base of that system to the upper coal measures inclusive. Scarcely a single igneous dyke or mineral vein intrudes itself into this, or the next more western division of the Appalachians.

The north-western belt of the Appalachians is a long and comparatively high table land, called the Alleghany Mountain in Pennsylvania, the Sewell Mountain in Virginia, and the Cumberland Mountain in Tennessee. Almost the whole way continuously from north-eastern Pennsylvania to northern Alabama, it presents a high escarped slope, facing south-eastward toward the middle chain. This table land is composed of nearly horizontal strata of the upper Devonian formations at its base, and of carboniferous rocks in its higher parts, wide tracts of it being covered exclusively by bituminous coal measures. Along its south-eastern border it is gently undulated with parallel broad regular anticlinal and synclinal flexures of the strata, the expiring waves of the middle Appalachian belt, where these crests are stronger, steeper, and more crowded. The plateau subsides to the north-west with the dying out of these flexures, and sinks into the broad plain of the basins of the Ohio and Mississippi.

A longitudinal survey of the Appalachian chain shows much undulation in its direction, and discovers ten distinct sections as respects its trend. Five of these are straight, three of them convex towards the north-west, and two of them convex towards the south-east.

C. THE ROCKY MOUNTAINS, OR CHIPPEWAYAN CHAIN.

This very elevated mountain axis, or main water-shed of the continent, consists generally of two, but in some districts of three, principal ranges, each composed of many high mountain crests, deep valleys, and elevated table lands. The great component ranges are approximately parallel, but they are variously linked and inosculated by transverse ridges. Their crest lines undulate on a stupendous scale, and many of their summits are sharply notched and serrated like the Alps. The main eastern range rises like a huge rampart above the great table land at its base, presenting a deeply gashed flank and vast mountain buttresses towards the plain. Longitudinally the whole chain consists of many sections broken by deep passes, and by the cessation of the leading ridges, which, in many instances, do not join, but lap past each other. This recently ascertained feature presents unexpected facilities for the construction of railways, and other avenues of communication across the continent. In Northern Mexico the eastern range is the Cordillera of Cohahuela and Potozi, the Guadaloupe Mountains being only an outlaying chain of ridges; and the western range is the Sierra de los Mimbres. Opposite the sources of the Arkansas, the eastern belt is the Moro and Chowatche, or Wet Mountain; and the western the San Juan and La Plata Mountains. The Noble valley of the Rio del Norte is here embraced between the two ranges. From the Arkansas to the north fork of the Platte, the chain is more complex and triple; its eastern range, comprising the Medicine Mountain, contains some of the loftiest peaks of the Rocky Mountains: such are the Spanish Peaks, Pike's, Long's, and Laramie's Peaks, all rising to 10,000 and 12,000 feet above the sea. North of the Platte rise the Wind River Mountains, the loftiest division of the chain. Here Fremont's Peak has an elevation of 13,568 feet. This high mountain axis is the focal water-shed of the continent, for it parts the head fountains of the Missouri flowing to the Atlantic, from those of the Columbia and Rio Colorado, descending westward to the Pacific.

Branching southward from the Rocky Mountains, near the Wind River range, is the long and lofty chain called the Wahsatch. It is the eastern boundary of the Great Utah Desert, and the western barrier of the basin of the Rio Colorado, the Rocky Mountains being the eastern. Northward of the Wind River chain the eastern, or main axis of the Rocky Mountains, is exceedingly high, where it divides the middle and northern streams of the Columbia from the sources of the Missouri and Saskatchawan. Near the head of the latter great river, Mount Hooker towers to the height of 15,700 feet above the sea; and a little further north, Mount Brown, the feeder of the river Athabasca, reaches the yet greater altitude of 15,990 feet. From this culminating district the chain gradually declines northward to the Arctic Ocean. Beyond lat. 55° the main eastern crest ceases to be the water-shed between the Pacific and Hudson Bay, or the Arctic Ocean.

The geological constitution and structure of the Rocky Mountains are very imperfectly known. Granite and gneissic rocks, and various palæozoic strata, including much carboniferous limestone, have, however, been extensively noticed in many districts. Between the higher ridges occur table lands and valleys, consisting apparently of cretaceous and tertiary deposits.

(To be Continued.)

For the Journal of the Franklin Institute.

Helices and Helicoidal Surfaces. By John M. Richardson, B. S.

A helix is a line which makes a constant angle with the horizon, and is generated by a point which moves so that the ratio of its ascent to the horizontal projection of the path described is constant.

A helicoidal surface consists of a series of helices in juxtaposition, and is generated by a line which moves so that each of its points describes a helix.

Let $z =$ length of helix;

$s =$ " horizontal projection;

$y =$ ordinate of helix;

$a =$ constant angle of helix; then

$$d\,z \cos a = d\,s\,;\; d\,z \sin a = d\,y \tag{1}$$

Integrating,

$$z \cos a = s\,;\; z \sin a = y \tag{2}$$

Squaring equations (2), and adding them,

$$z^2 = s^2 + y^2 \tag{3}$$

Dividing the first of (2) by the second,

$$s\,y^{-1} = \cot a \tag{4}$$

Equations (2,) (3,) and (4,) are well known trigonometrical formulas, and prove that the relations between any portion of a helix, its projection, and the difference between its extreme ordinates are the same as the relations between the hypothenuse and legs of a right-triangle.

The relations established above, are perfectly true, whatever may be the nature of the surface upon which the helix is located.

If z, or y, or s be given—a being known—the other two are easily determined.

To complete the determination of the helix, the equation of its horizontal projection must be ascertained.

Let $\rho =$ radius vector estimated from an assumed centre.

$\phi =$ angle made by ρ with directrix passing through initial point of projection;

Then,

$$s = \int (d\,\rho^2 + \rho^2 d\,\phi^2)^{1/2} = \mathrm{F}\,\phi \tag{5}$$

But

$$s = \mathrm{F}'\,\rho \tag{6}$$

Hence,

$$\mathrm{F}'\,\rho = \mathrm{F}\,\phi \tag{7}$$

(7) is the equation of the projection.

If the generatrix in its initial position be supposed to have an ordinate c, equations (2,) (3,) and (4,) will become

$$\left.\begin{array}{l} z \cos a = s\,;\; z \sin a = y - c\,; \\ z^2 = s^2 + (y - c)^2;\; s\,(y - c)^{-1} = \cot a \end{array}\right\} \tag{A}$$

The equation of a helicoidal surface is the same as that of a helix described by any point of its generatrix.

Let $\rho =$ distance of any helix from an assumed vertical axis;
$\beta =$ angle made by generatrix with horizon;
$c =$ ordinate of point in which generatrix in its initial position cuts the axis;
z, y, s, and a as before. Then

$$y = c + \rho \tan \beta + s \tan a; \; z = (y - c - \rho \tan \beta) \operatorname{cosec} a \tag{8}$$

If $\beta = o$, equations (8) will become

$$y = c + s \tan a; \; z = (y - c) \operatorname{cosec} a \tag{9}$$

If $c = o$, equations (8) will become

$$y = \rho \tan \beta + s \tan a; \; z = (y - \rho \tan \beta) \operatorname{cosec} a \tag{10}$$

and equations (9)

$$y = s \tan a; \; z = y \operatorname{cosec} a \tag{11}$$

The general investigation is simple enough, but when the results are applied to particular cases, it assumes a more difficult form.

Helix on right cylinder with circular base.

$h =$ height of cylinder; $r =$ radius of base.

$$\left.\begin{array}{ll} z = h \operatorname{cosec} a; & s = h \cot a \\ \rho = r; & \phi = h r^{-1} \cot a \end{array}\right\} \tag{12}$$

For the area of the helicoidal surface whose generatrix passing through the centre of the base in its initial position, does not extend beyond the surface of the cylinder.

$$\text{A} = r \sec \beta \cos a' \operatorname{cosec} a \, (h - r \tan \beta) \tag{13}$$

$\sin a' = \sin a \sin \beta$; and if $\beta = o$, $a' = o$ also, and (13) becomes

$$\text{A} = r h \operatorname{cosec} a \tag{14}$$

Right cone with circular base.

$h =$ height of cone; $r =$ radius of base.

$$\left.\begin{array}{l} z = y \operatorname{cosec} a; \; y = s \tan a \\ \rho = r h^{-1}(h - y) = r h^{-1}(h - s \tan a) \end{array}\right\} \tag{15}$$

Substituting in (5),

$$s = h \cot a \left(1 - e^{-r \phi \tan a \, (h^2 - r^2 \tan^2 a)^{-\frac{1}{2}}}\right) \tag{16}$$

From the last of equations (15,)

$$s = h \cot a \, (1 - r^{-1} \rho) \tag{17}$$

Comparing (16) and (17),

$$\rho = r \, e^{-r \phi \tan a \, (h^2 - r^2 \tan^2 \mathrm{a})^{-\frac{1}{2}}} \tag{18}$$

For the area of the helicoidal surface whose generatrix passing through the centre of the base in its initial position, does not extend beyond the surface of the cone.

$$\text{A}' = 2^{-1} r' \cos a' \operatorname{cosec} a \, (h - r \tan \beta) \tag{19}$$

$\sin a' = \sin a \sin \beta$; $r' = r h \, (h^2 + r^2)^{-\frac{1}{2}} \operatorname{cosec} \left[\beta + \overset{-1}{\sin} h \, (h^2 + r^2)^{-\frac{1}{2}} \right]$

If $\beta = o$, then $a' = o$, and (19) becomes

$$\text{A}' = 2^{-1} r h \operatorname{cosec} a. \tag{20}$$

Helix on sphere.

The plane of reference passes through the centre of the sphere.

$r =$ radius of sphere ; z, s, &c., as before.

$$\left.\begin{array}{l} z = y \operatorname{cosec} a;\ y = s \tan a \\ \rho = (r^2 - y^2)^{\frac{1}{2}} = (r^2 - s^2 \tan^2 a)^{\frac{1}{2}} \end{array}\right\} \qquad (21)$$

Substituting in (5) and then placing for s its value derived from the last of equations (21) there results,

$$\left.\begin{array}{l} \phi = \overset{-1}{\tan}\left[\tan \tfrac{1}{2} a \left(r \cos a - [r^2 - \rho^2]^{\frac{1}{2}}\right)^{\frac{1}{2}} \left(r \cos a + [r^2 - \rho^2]^{\frac{1}{2}}\right)^{-\frac{1}{2}}\right] \\ + \overset{-1}{\tan}\left[\cot \tfrac{1}{2} a \left(r \cos a - [r^2 - \rho^2]^{\frac{1}{2}}\right)^{\frac{1}{2}} \left(r \cos a + [r^2 - \rho^2]^{\frac{1}{2}}\right)^{-\frac{1}{2}}\right] \\ - 2 \operatorname{cosec} a \overset{-1}{\tan}\left[\left(r \cos a - [r^2 - \rho^2]^{\frac{1}{2}}\right)^{\frac{1}{2}} \left(r \cos a + [r^2 - \rho^2]^{\frac{1}{2}}\right)^{-\frac{1}{2}}\right] + c \end{array}\right\} (22)$$

(22) is the equation of the projection of the helix traced on the upper half of the sphere.

For the area of the helicoid whose generatrix passing through the centre in its initial position, does not extend beyond the surface of the sphere.

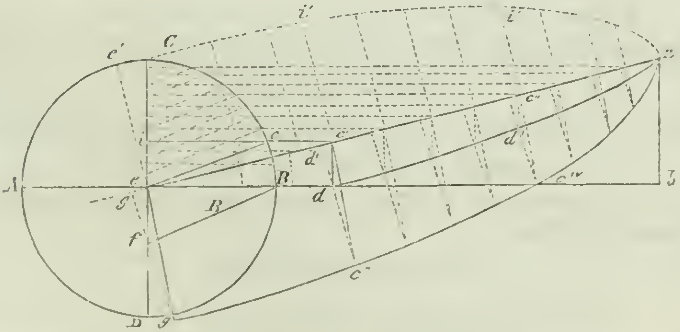
$$\left.\begin{array}{l} A'' = 2^{-2} r^2 \Big(\cos a' \operatorname{cosec} a \sec \beta \Big[\pi - 2 \sin \beta \cos^2 a \\ \left(1 - \overset{2}{\sin} \beta \overset{4}{\cos} a\right)^{\frac{1}{2}} - 2 \overset{-1}{\sin}\left(\sin \beta \overset{2}{\cos} a\right)\Big] - \sin 2 a'\Big) \end{array}\right\} \qquad (23)$$

$$\sin a' = \sin a \sin \beta.$$

If $\beta = o$, $a' = o$, and (23) becomes

$$A'' = 2^{-2} r^2 \pi \operatorname{cosec} a \qquad (24)$$

By proceeding in the same manner, helices may be readily located on ellipsoids, paraboloids, and hyperboloids of revolution. Their determination will be found to present several interesting examples of the integral calculus, and will be instructive and entertaining.



NOTE.—The method of determining the areas of the helicoids, generated in the several cases considered, does not appear very plainly in the preceding investigation; and I present here, in the form of a note, an example of the general method by determining the area of the helicoid in the case of the sphere.

Roll the sphere along the great circle AB. The helix traced by the extremity of the generatrix which passes through e, and is perpendicular to the plane of the paper, will drop off and become ea: the one traced by the extremity of $e\,i$, represented in its true length by $e\,c$, and which makes the angle $c\,e\,\mathrm{B}=\beta$ with the plane through e perpendicular to CD, will drop off and become $c'a$. The helicoid generated by the first, is projected in $e\,a$. Revolving it about $e\,a$ until it coincides with the plane of the paper, it becomes $e\,c'\,c''\,a\,i''\,i'\,e'$. The helicoid generated by the second is projected in $c'\,c''\,a\,d'\,d$. Revolving it about $c'\,a$ until it coincides with the plane along which the sphere is rolled, it becomes $c'\,c''\,a\,c^{\mathrm{V}}\,c'''$.

$$c'\,i'=\rho=(r^2-y^2)^{\frac{1}{2}}=(r^2-z^2\sin^2 a)^{\frac{1}{2}}. \quad \text{Hence}$$

$$\rho^2+z^2\sin^2 a=r^2 \tag{a}$$

By a simple transformation (a) becomes

$$r^2\operatorname{cosec}^2 a.\ \rho^2+r^2 z^2=r^4\operatorname{cosec}^2 a \tag{b}$$

(b) is the equation of an ellipse, the axes being $2\,r$ and $2\,r\operatorname{cosec} a$.

The area of $e\,c'\,c''\,a\,i''\,i'\,e'$ can be readily found now; though it is best to take the more general case in which the generatrix makes an angle β with the plane through e, perpendicular to CD. $c'\,c''\,a\,c^{\mathrm{V}}\,c'''$ is the helicoid whose generatrix, passing through the centre of the sphere in its initial position, does not extend beyond the surface, whilst $e\,c'\,c''\,a\,c^{\mathrm{V}}\,c''\,g$ is the helicoid whose generatrix is seen in projection in $f\,e$, and in its true length in fB, and which makes an angle with β the plane of reference.

$$e\,c'\,c''\,a\,c^{\mathrm{V}}\,c'''\,g=g'\,e\,c'\,c''\,a\,c^{\mathrm{V}}\,c'''\,g-g'\,e\,g \tag{c}$$

$g'\,e\,g$ is a right triangle, and is equal to $\frac{1}{2}\,g\,g'\times g'\,e$.

Let $g'\,g\,e=a'$, then, since $e\,g=f\mathrm{B}=r\sec\beta$,

$$g\,g'=r\sec\beta\cos a',\ \text{and}\ g'\,e=r\sec\beta\sin a'. \quad \text{Hence}$$

$$g'\,g\,e=\tfrac{1}{2}\,r^2\sec^2\beta\sin a'\cos a'=2^{-\frac{1}{2}}\,r^2\sec^2\beta\sin 2\,a' \tag{d}$$

$$g'\,f\,e=a,\ \text{and}\ f\,e=r\tan\beta.\ \therefore g'\,e=r\tan\beta\sin a$$

Comparing this value of $g'\,e$ with that already obtained,

$$\sin a'=\sin a\sin\beta. \tag{e}$$

Let $c'\,c'''=\mathrm{P}$, then $\rho=\mathrm{P}\cos\beta$. Substituting in (a), and transforming,

$$\mathrm{P}^2\,r^2\operatorname{cosec}^2 a+z^2\,r^2\sec^2\beta=r^4\operatorname{cosec}^2 a\sec^2\beta. \tag{f}$$

(f) is the equation of an ellipse referred to its conjugate diameters, the diameters being

$$2\,r\operatorname{cosec} a\ \text{and}\ 2\,r\sec\beta.$$

$$d''\,c'\,c''\,a\,c^{\mathrm{V}}\,c'''=\int\mathrm{P}\cos a'\,dz=\mathrm{A}''+d''\,c''\,c' \tag{g}$$

$$d''\,c''\,c'=\tfrac{1}{2}\,d''\,c'''\times d''\,c'=\tfrac{1}{2}\,r\cos a'\times r\sin a'=2^{-2}\,r^2\sin 2\,a' \tag{h}$$

Substituting in (g) and transposing

$$\mathrm{A}'' = \int \mathrm{P} \cos a' \, d z - 2^{-2} \; r^2 \sin 2 a' \qquad (i)$$

From (f), $\mathrm{P} = \sec \beta \, (r^2 - z^2 \sin^2 a)^{\frac{1}{2}} = \sec \beta \sin a \, (r^2 \operatorname{cosec}^2 a - z^2)^{\frac{1}{2}}$

Substituting in (i),

$$\mathrm{A}'' = \cos a' \sin a \sec \beta \int (r^2 \operatorname{cosec}^2 a - z^2)^{\frac{1}{2}} d z \qquad (k)$$

Integrating and taking z between the limits

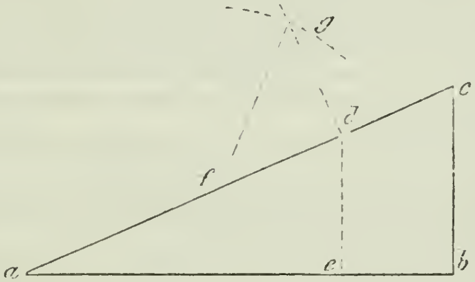
$$z = e a = r \operatorname{cosec} a, \text{ and } z = e d'' = r \sin \beta \cos^2 a \operatorname{cosec} a.$$

$$\left.\begin{array}{l} \mathrm{A}'' = 2^{-2} r^2 \Big(\cos a' \operatorname{cosec} a \sec \beta \Big[\pi - 2 \sin \beta \cos^2 a \\ \left(1 - \sin^2 \beta \cos^4 a\right)^{\frac{1}{2}} - 2 \sin^{-1} \left(\sin \beta \cos^2 a \right) \Big] - \sin 2 a' \Big) \end{array}\right\} \quad (m)$$

(m) is the same as (23).

If z be taken between the limits, $e g' = -r \sec \beta \sin a$; and $e a = r \operatorname{cosec} a$, $g' e c' c'' a c^{\mathrm{IV}} c''' g$ will be obtained, then subtracting $g' g e$ the area of the helicoid $e c' c'' a c^{\mathrm{IV}} c''' g$, whose generatrix is seen in projection in $f e$ will be obtained.

Equation (a) gives rise to the following method of determining points of the ellipse.



The semi-axes being given, construct a right triangle $a b c$, whose hypothenuse is equal to the semi-major axis, and the altitude to the semi-minor axis. At any point, as d, on the hypothenuse erect a perpendicular thereto, and through the same point let fall a perpendicular de on the base $a b$; then lay off $d f$ on the hypothenuse equal to $d e$, and with f as a centre, and a radius equal to $b c$, the semi-minor axis, describe an arc cutting the first perpendicular in g; g will be one point of the ellipse. Other points can be determined in the same way, and the curve then traced through them. It is evident that g will be one point of the ellipse. For, in equation (a), ρ denotes the ordinate, and z the abscissa; and if, in the figure, $a d = z$, $d g = \rho$, $b a c = a$, there will result,

$$d e = d f = z \sin a; \text{ and consequently,}$$

$$(f g)^2 = r^2 = \rho^2 + z^2 \sin^2 a \qquad (n)$$

AMERICAN PATENTS.

List of American Patents which issued from February 10th, to March 3d, 1857, (inclusive,) with Exemplifications.

FEBRUARY 10.

56. For an *Improvement in Stuffing Leather;* Joseph Armstrong, Woburn Centre, Massachusetts.

Claim.—"Employing a press previous to, and in connexion with, the application of the oil or grease by a peg-lined cylinder, or other equivalent means, the press removing the liquor and contracting the hide, and the peg-lined cylinder, subsequently restoring or plumping it and impregnating it with grease."

57. For an *Improvement in Melodeons;* J. C. Briggs, Woodbury, Connecticut.

Claim.—"The expression chamber with its valve."

58. For an *Improvement in Fire Arms;* Francis S. Brettell and John B. Frisbie, Alleghany City, Pennsylvania.

Claim.—"The arrangement of the pawl or catch, notch, and claw on the hammer, and the cam on the trigger, or any other arrangement substantially the same, for the purpose of keeping the hammer and the trigger in their respective positions when at full cock."

59. For an *Improved Machine for Making Envelopes;* Theodore Bergner, Philadelphia, Pennsylvania.

Claim.—"1st, Giving the sliding rod a downward movement, by means of link, lever, rod, and cam. 2d, Giving a sliding movement to the frame, by means of link, lever, rod and cam, thereby operating, by means of lifters, the folding hinges. 3d, The compartments, in combination with pipe and cylinder, the latter being provided with piston, which is operated by cam on the shaft. 4th, The stamp, working in the swivel bearing, and operated by cam, pin, rod and cam. 5th, The employment of cam-lever, rod-arm, and spiral spring, to turn swivel bearing on its axis. 6th, Operating the pasting vessels, by the lever, rod, and cam. 7th, Applying the curved arm, working in a slot, through the folder, for removing the finished envelopes to the inclined table, and operating it by arm, and cam-arm."

60. For an *Improved Mode of Attaching Thills to Sleighs;* J. M. Batchelor, Foxcroft, Maine.

Claim.—"Attaching the thills to the bar, which bar is fitted within a grooved bar attached to the sleigh—the bar being allowed to slide within the grooved bar, and secured at the desired points by the spring catch."

61. For an *Improvement in Extension Hoppers for Separators, Grain Mills, &c.;* John Bean, Hudson, Michigan.

Claim.—"The combination of an adjustable extension piece, with the hopper."

62. For an *Improvement in Shoes for Truss Frames;* Reuben Comins, Troy, N. Y.

Claim.—"Furnishing that description of shoe, which at the part where the braces rest is of an inverted T, or angular or curved form, with two projecting plates on its under side, which, in their horizontal section, are of T form—said plates passing through the stringers on each side of the vertical rods, and thus forming an opening, or jaws, for the vertical rods to pass between, and extending down from the surface of the shoe which rests upon the stringers, to the nuts and washers upon the under side of the stringers."

63. For *Improved Gunpowder;* Elisha B. Dodson, Reading, Pennsylvania.

Claim.—"The treatment of mineral coal, preparatory to using the same as a substitute for charcoal, in the manufacture of gunpowder and blasting powder."

64. For an *Improved Printing Stamp;* Wm. H. Elliot, Plattsburgh, New York.

"The nature of my invention consists in the arrangement of certain devices for a printing stamp, by which the type or die is caused to pass from the ink pad or roll, to the impression pad to make the impression, and back to the ink pad again for the ink—the power being applied by the hand or foot."

Claim.—"1st, The crank, joint, or their equivalents, when used in combination with type or die. 2d, The same, in combination with the treadle. 3d, The self-adjusting ink pad. 4th, Tilting the ink pad, so that by the action of the type, or dies upon it, it may be revolved. 5th, The combination of the die or type with the crank, when arranged in relation to the two pads."

65. For an *Improved Raking Attachment for Reapers;* Peter Harnist, Marinetown, Illinois.

Claim.—"Operating the rod to which the rake head is pivoted, by means of rock-shaft arms, and connecting in combination with spring, crank, and bar."

66. For an *Improvement in Razor Strops;* Edward K. Godfrey, City of New York.

Claim.—"The use of an independent strop stock, without handles, in combination with adjustable and independent backs."

67. For an *Improvement in the Mode of Attaching the Eyes to the Blades of Hoes;* Henry Havell, Newark, New Jersey.

Claim.—"The cap which forms a socket with the blade to receive the malleable iron eye, and becomes a part of the same."

68. For an *Improvement in Seed Planters;* Thomas B. Houghton, Bloomington, Ill.

Claim.—"Operating the planting slide and tube, by means of a crank receiving its motion from one or both of the carriage wheels. Also, the reciprocating frame, or its equivalent, so constructed and operated as to guide the planting tube, and make it deposit the seed in the ground at the desired point."

69. For an *Improvement in Guides for Sewing Machines;* Addison Hull, Brooklyn, New York.

Claim.—"The attachment of the guide plate to a spring bar, or its equivalent, which operates independently of the foot piece, thus holds the cloth during the sewing operation, and is adjusted laterally to the same, and the connexion of the same by a vertically slotted connexion, with a slotted sliding plate working through the foot piece, whereby the guide plate is made adjustable and changeable."

70. For an *Improved Machine for Ramming Percussion Caps;* Charles Hicks, Haverstraw, New York.

Claim.—"1st, The pistons, arranged in a row, and receiving reciprocating rectilinear and circular movements, simultaneously operating, in combination with the traveling carrying plate, or other equivalent device, for carrying the caps. 2d, Producing the circular movement of the piston by means of pinions on the said pistons, gearing with a toothed rack that receives a sliding movement laterally to the frame which carries the pistons, and imparts to them the rectilinear movement from a lever operated by a cam on the crank-shaft, by which the rectilinear movement of the pistons is produced. 3d, The employment of the stationary plate, in combination with the reciprocating pistons, and the traveling carrying plate."

71. For an *Improved Method of Surfacing Felt Hats;* Alvin Hurd, Danbury, Conn.

Claim.—"Surfacing the hat upon the elastic cover or bed."

72. For an *Improvement in Feathering Paddle Wheels;* Lewis T. Howard, Smith Mills, Mississippi.

Claim.—"The connecting the cranks of the paddle shafts with each other, around and with the stationary governing wheel, by means of the connecting bars, and the grooved rollers, or their equivalents."

73. For an *Improvement in Seed Planters;* John Hildebrand, East Berlin, Penna.

Claim.—"The combination of the spring connexion, and slides, and scrapers, and the vibrating head cam."

74. For an *Improved Gas Making Process;* James Hansor, Wandsworth Road, England.

Claim.—"The treatment of the compound gas fuel, worked in the retorts."

75. For an *Improvement in Seed Planters;* Reinhold Bocklen, Jersey City, N. J.

Claim.—"The distributor, having chamber and recesses, and worked between the compartments, and by means of the link and slide, in combination with the cut-off and plate."

76. For an *Improved Arrangement of Means for Controlling the Throttle Valve of Marine Engines;* Wm. H. Elliot, Plattsburgh, New York.

Claim.—"The chamber, cylinder, plunger, and spring, when arranged in relation to the engine and to the hull of the vessel, and to each other."

77. For an *Improved Sash Fastener;* Wm. W. Kellogg, Lynn, Massachusetts.

Claim.—"The use of the hasps constructed and operating in connexion with the perforated cleat and upper sash."

78. For an *Improvement in Safety Indicators for Steam Boilers;* Lucius J. Knowles, Warren, Massachusetts.

Claim.—"Connecting the pipe with the boiler by means of the feed pipe, the same being productive of an advantage."

79. For an *Improvement in Seed Planters;* Jacob Landes, Selma, Ohio.

Claim.—"Pivoting the cut-off to the bar, so that the cut-off shall have an oscillating movement, and thus stir the seed when it oscillates."

80. For an *Improved Fence adaptable to Uneven Ground;* G. R. McIlroy, Covington, Kentucky.

Claim.—"The combination of the adjustable bar and oblique pin, with an angularly braced panel and bearer, or any ordinary panel on which the angular or other bar may be supported, so that the panels may be moved sideways at the bottom, so as to bring them perpendicular upon uneven ground, and secured in that position by one or two adjustable bars or seats."

81. For an *Improvement in Reaping and Mowing Machines;* Jeremiah W. Mulley, Amsterdam, New York.

Claim.—"Constructing and arranging the platform of combined reaping and mowing machines in parts, when one or more of said parts may occupy at pleasure such position in relation to the cutters as to form the track clearer for mowing, or the platform for reaping."

82. For an *Improved Process for Ornamenting Daguerreotype Cases, &c.;* John F. Mascher, Philadelphia, Pennsylvania.

Claim.—"The process of ornamenting daguerreotype cases, or other articles, in imitation of tortoise shell, wood, marble, or other substances, by first covering the surfaces thereof with stained or colored paper of suitable character, or staining or coloring the surfaces themselves in a suitable manner, and afterwards coating them with gelatine, and bi-chromate of potash."

83. For an *Improvement in Preparing India Rubber Cloth;* Gulielmus B. Millerd, Colchester, Connecticut.

Claim.—"The application of a sheet of vulcanized caoutchouc, previously prepared by buffing its surface or surfaces to a sheet of cloth, or between two sheets of cloth previously prepared, by being thinly coated with an unvulcanized solution of caoutchouc on the tangent side or sides; the sheet of caoutchouc being applied in an extended state to produce an extensible and elastic, or in a free state to produce an unelastic."

84. For an *Improved Abdominal Supporter;* Julia M. Milligan, New Albany, Ind.

Claim.—"The application of the whalebone, and the cords or strings, by which the requisite mechanical support may be obtained."

85. For an *Improvement in Chain Pumps;* Edmund Morris, Burlington, N. J.

Claim.—"The application of an elastic flexible tube, in combination with the box or chamber in which it is enclosed, for the purpose of retaining water to assist in packing the pump."

86. For an *Improvement in Gauges and Water Regulators for Steam Boilers;* Mighill Nutting, Portland, Maine.

Claim.—"The arrangement of the expanding chamber in relation to the opening for steam in the heating apartment, so that the steam from the boiler, when it is admitted to this apartment, is suddenly brought into contact with the surface of the lower part of the chamber, within the apartment, and remains in contact with the same until the water in the boiler rises to the top of the opening which admitted the steam, when the contact of the steam with the chamber is suddenly cut off."

87. For an *Improvement in Rail for Street Railroads;* Samuel Nicolson, Boston, Mass.

Claim.—"My improved street rail, with recesses in its side or sides, for the reception of the paving blocks, each recess of one side being opposite either a recess of the other side, or space between two recesses of the other side."

88. For an *Improved Arrangement of Devices for Suspending and Adjusting Sticks in Sawing Machines;* Ezekiel Page, Platea, Pennsylvania.

Claim.—"Constructing the head and tail blocks of a saw-mill, in which the log is so suspended as to rotate with the vertical and lateral adjustments, arranged and combined so that the log may be sawed radially and tapering for the purpose of getting out oars therefrom."

89. For an *Improvement in Ventilating Stoves;* Luther M. Parsons, Wawkan, Wis.

Claim.—"The arrangement of the pipes, bent pipe, bar, provided with valves, and the expansion rod."

90. For an *Improved Hand Stamp;* Perley A. Ramsay, Boston, Massachusetts.

Claim.—"1st, The arm, pivoted to the truck, in combination with the stop and ink roll. 2d, The method of hanging the ink roll."

91. For an *Improvement in Sewing Machines;* Thomas J. W. Robertson, City of New York.

Claim.—"The spiral groove in the needle leading upward from the eye on one side, in combination with the looper. Also, the loop guide, in combination with the looper for laying the loop. Also, the guard pin, or its equivalent."

92. For an *Improvement in Seed Planters;* Silas G. Randall, Rockford, Illinois.

Claim.—"In combination with the shoe or spade, composed of the pieces, the bars."

93. For an *Improvement in Corn Planters;* Martin Robbins, Cincinnati, Ohio.

Claim.—"The reversible hopper and arms, with the vibrating claw or tappet connected with seeding mechanism, in combination with the jointed rod or chain provided with buttons or similar devices."

94. For an *Improvement in Attaching the Arms of Horse Powers;* Cyrus Roberts, Belleville, Illinois.

Claim.—"The combination of the radial rigid arms and intermediate hinged and suspended sweeps with the master-wheel."

95. For an *Improvement in Rotary Steam Engines;* John B. Root, Buffalo, New York.

Claim.—"1st, The central hub when used as a support for friction rollers. 2d, The arrangement of friction rollers within the piston, upon the central hub. 3d, The piston, when used in acting upon friction rollers. 4th, The combination of the sliding frame, the self-adjustable boxes, the driving-ring, and the wedge, for the purpose of regulating the bearing of the friction rollers upon the piston and central hub."

96. For an *Improved Metallic Roofing;* Benjamin Ross and John C. Campbell, Syracuse, New York.

Claim.—"The method of connecting together metallic plates or shingles for roofing by their own weight, when the series of plates so connected are fastened only at the upper and lower edge of the roof."

97. For an *Improvement in Instruments for Facilitating the Facing of Mill-Stones;* Benjamin D. Sanders, Holliday's Core, Virginia.

Claim.—"The instrument consisting of the slotted beam, cross-arm, elastic pointer, box carrying the adjusting screw, spindle, and adjustable base or stand, or the equivalent of these devices, constructed and arranged in relation to each other for joint operation."

98. For an *Improved Self-Adjusting Wind-Wheel;* Edward A. Tuttle, Brooklyn, New York.

Claim.—"Placing the sails, or a greater number, in a position before the wind, and then causing them to perform complete rotation upon their axis, in the time relatively with those of the wind-wheel, and in the direction by connecting them with the crown-wheel, in any manner producing the same result. Also, the crown-wheel and vane, connected with the sails by means of the pinion wheels. Also, combining with the horizontal rotary motion of the sails upon their axis, the perpendicular, adjustable, vibratory motion, by which they are rendered self-regulating in a most simple manner, although presenting reverse sides to the wind at each succeeding revolution of the wind-wheel. Also, the method of assisting the sails to perform their rotation upon their axis, by means of the reverse projecting rims upon the bottom edges."

99. For an *Improvement in Seed Planters;* H. Thomason, Lafayette, Indiana.

Claim.—"Operating the distributing device or slide, by means of the lever or rod, having the arm attached to its fulcrum bar, which has a spring connected with it and the collar or tube, on the handle of the implement; the collar or tube being provided with an arm extending underneath the arm of the fulcrum bar."

100. For an *Improvement in Harvesting Machines;* Walter A. Wood, Hoosick Falls, New York.

Claim.—"Making the raker's seat or stand adjustable in the arc of a circle, on the rear part of the frame."

101. For an *Improvement in Harvesting Machines;* Walter A. Wood, Hoosick Falls, New York.

Claim.—"In combination with the finger bar and shoe, a track clearer hung to said bar by a spring, and playing vertically between, but resisted laterally by the lugs on said shoe, when said parts are constructed and arranged in relation to each other."

102. For an *Improvement in Harvesting Machines;* Walter A. Wood, Hoosick Falls, New York.

Claim.—"Connecting and disconnecting the gear by a clutch lever, with its cam planes and handle extending up through the support, to a convenient position for the operator."

103. For an *Improvement in Apparatus for Indicating the Height of Water in the Holds of Vessels;* Wm. R. Warden, Boston, Massachusetts.

Claim.—"Operating the alarm apparatus, by means of the ball carrier's inclined tube and lever, with their co-operating mechanism."

104. For an *Improvement in Wool Cleaning Machines;* William H. Watrons, Brooklyn, New York.

Claim.—"The combination of the picker cylinder, reciprocating screen, exhaust screen, and fan-blower."

105. For an *Improvement in Locomotive Cow-Catchers for Railroads;* Joel Wisner, Aurora, New York.

Claim.—"1st, The bar or jaw, legs, feet, and teeth, when operated by the springs, or their equivalent, in combination with the forward end beam of the locomotive. 2d, The stud and joint, in combination with the bar."

106. For an *Improved Machine for Re-sawing Lumber;* Simon P. Winne, Albany, New York.

Claim.—"1st, Connecting the slides of the two roller frames by arms. 2d, Connecting the two upper and outer rollers in the frames, to the two lower rollers in the frames, by means of the rods, so that a rotary motion is communicated to the lower rollers from the upper ones, and the upper rollers allowed to have an independent lateral movement."

107. For an *Improvement in Fishing Rod Reels;* Edward Deacon, Brooklyn, N. Y., Assignor to John Warren, City of New York.

Claim.—"Connecting the crank-shaft with the reel-shaft, and also disconnecting it therefrom, by means of the slotted sleeve placed or fitted upon the shaft, and within the socket."

108. For an *Improved Machine for Cutting Dovetails and their Grooves;* E. G. Matthews, Clear Water, Minnesota Territory, Assignor to Harvey Church, Troy, New York.

Claim.—"In combination with the fixed stock, the mitering knife, and scouring and cleaning knives, for forming, at one operation, the miter and dovetail, tongue or groove. Also, in combination with the fixed stock, and mitering, and dovetail cutter, the traversing of the block or board in a clamped condition past the same, for the purpose of having the miter and dovetail formed therein."

109. For an *Improvement in Calendar Clocks;* Edwin P. Monroe, Albany, N. Y., Assignor to Gilbert H. Scribner, City of New York.

Claim.—"The displacing of cards, for the purpose of enumerating and designating the day, said cards being suspended upon wires, and displaced by means of a hand, moved and operated by the machinery of the common hour clock, or by any other machinery appropriate for the same purpose."

110. For an *Improved Mode of Patching Bullets;* Frederick D. Newbury, Assignor to Richard Varick De Witt, Jr., Albany, New York.

Claim.—"The mode of securing a patch upon conoidal or similar bullets, by compressing the upper portion of the patch under a thin ledge of the metal of the bullet."

111. For an *Improved Arrangement of Springs for Vehicles;* Darius Babcock, Assignor to self, and Thomas Harrop, Homer, New York.

Claim.—"The combination of the c spring and sinuous spring, connected by rigid bars to the body of the vehicle."

112. For an *Improvement in Making Seamless Tubes;* Wm. S. Platt, Assignor to self, and Alfred and Clark M. Platt, Waterbury, Connecticut.

Claim.—"So forming the groove upon each sector, that the breadth and depth thereof shall gradually diminish from one end to the other, whereby the size of the central hole formed by a set of the said sectors, when arranged for operating, shall increase or diminish as the sectors vibrate or rotate."

113. For an *Improvement in Manufacturing Metallic Beads;* John R. Wendt, Assignor to self and Augustus Rogers, Boston, Massachusetts.

Claim.—"My improved manufacture of hollow beads of metal, as made by the operations of reducing the metal to a tubular form, and that of compressing it axially in dies."

114. For *Improved Window Blinds;* Daniel Kelley and William Livingston, Grand Rapids, Michigan.

Claim.—"Constructing the slats, and having strips attached to the stile, whereby the slats, when closed, will overlap and be flush with each other, at each side, and the slats rendered perfectly weather proof, and the light excluded."

115. For an *Improvement in Machines for Husking Corn;* Ezra S. Holmes, Lockport, New York.

Claim.—"1st, The huskers, consisting of the guides and of the hands, or their equivalents. 2d, The combination of the huskers with the shears."

116. For an *Improved Process for Smelting Zinc Ore;* Joseph C. Kent, Cooper Iron Works, New Jersey.

Claim.—"The peculiar process of alternating in the blast furnace, the Franklinite, and other ores of iron and zinc, with ordinary ores of iron, for the production of cast iron and oxide of zinc, by which process I maintain the equilibrium of heat, and keep the furnace in successful operation."

FEBRUARY 17.

117. For a *Self-setting Hair-Triggered Gun Lock;* Jonathan Altman, Armstrong Co., Pennsylvania.

Claim.—"The mode of setting the double trigger by the act of cocking the gun."

118. For an *Improvement in Extension Chairs;* Samuel J. Anderson and Nelson Richardson, Erieville, New York.

Claim.—"The levers and folding seats attached to the box, the box being formed of two parts connected by a hinge."

119. For an *Improvement in Seed Planters;* Leonard Arnold, Janesville, Wisconsin.

Claim.—"Employing two frames in constructing the machine, the forward frame resting on the axle of the principal or driving-wheels, and the rear frame resting on the axle of the covering-wheels, and extending forward and under the forward frame to which it is jointed, and acting as a lever in elevating the forward frame, driving-wheels, and ploughs, clear from the ground, in turning round and passing from point to point."

120. For *Photographic Camera Box;* Luzerne M. Bolles and Washington G. Smith, Cooperstown, New York.

Claim.—"1st, A swing, with ground glass permanently attached. 2d, The arrangement of the baths in the camera box to correspond with the operations of the plate holder, through the mortise and grooves."

121. For an *Improved Machine for Making Hames;* Henry Burt and James T. Hedden, Newark City, New Jersey.

Claim.—"The use of the consecutive ring dies, in connexion with the angular grooves and stops on the feed rollers."

122. For an *Improvement in Gas Regulators;* John H. Cooper, Philadelphia, Pa.

Claim.—"Placing the spring regulating the valve within the latter, made hollow for the purpose, in order to prevent the contact of the gas with the spring."

123. For an *Improvement in Bosoms Pins;* John P. Derby, South Reading, Mass.

Claim.—"Extending the arm around the end and along the side of back of brooch, so that the point of pin being retained in the fingers can be entered under its extreme end, thus allowing said point to be protected by a guard when revolved to place. Also, the combination of collar with the cap and the post, which admits of the easy attachment of the pin."

124. For an *Improved Carpenter's Bench Clamp;* James E. A. Gibbs, Mill Point, Virginia.

Claim.—"Combining the pivoted and bent clamp rod, with the sliding arm or lever, when the latter is so arranged as to jam the rod at any required height, by means of screw or cam, or any other equivalent mechanical contrivance."

125. For an *Improved Device for Allowing Circular Saws to Play Laterally, Independently of their Shafts;* A. P. Gross, St. Louis, Missouri.

Claim.—"The shaft, in combination with the sleeve and springs, the saw being attached to the sleeve, and the shaft secured in its bearing so as to prevent a longitudinal movement of the same."

126. For an *Improved Chimney Cowl;* Moses H. Hale and Samuel Horton, Newburyport, Massachusetts.

"Our improvement has reference to the chimney cap or ventilator, on which Letters Patent of the United States of America, were granted to Frederick Emerson, of Boston, Massachusetts.

Claim.—"The improved cap constructed with a discharge pipe, the inverted frustrum, the outer frustrum, its wind passages, and the shield or fender."

127. For an *Improved Method of Generating Air Blast;* Isaiah J. Hendryx, City of New York.

Claim.—"1st, The cylinder constructed with a hollow shaft, and divided into compartments either on a line with the shaft, or spirally around it, said cylinder being partly immersed in water or other liquor, and revolving at an angle. 2d, The cylinder, with or without a hollow shaft, and extending the air chamber above and below the cylinder, said chamber passing far enough below the water line to prevent the escape of the air, the air being supplied to the cylinder through the hollow shaft, or by pipes passing along it to the outside of the chamber, said pipes having valves opening inwards or immersing. 3d, The cylinder, revolving at an angle without being immersed with the liquor inside said cylinder. 4th, The application and use of the cylinder, its case and contents, for the purpose of passing air through hydro-carbons and their vapors, or mixing air with other gases, for heating or illuminating, or any other purpose requiring a steady blast; I do not limit myself to the form of a cylinder, but claim any other shaped vessel, constructed of metal or other material."

128. For an *Improved Machine for Varnishing Percussion Caps;* Charles Hicks, Haverstraw, New York.

Claim.—" 1st, The combination of a vertically moving frame, carrying a number of wires or rods, or their equivalents, to take up the varnish, and suitable guides above the said trough to receive a plate which carries the caps: the whole being constructed and operated together. 2d, The plate containing holes corresponding in number and arrangement with the wires or rods, or their equivalents, arranged relatively to the trough, the vertically moving frame, and the guides."

129. For an *Improvement in Folding Bedsteads;* Benjamin Hinckley, Troy, N. Y.

Claim.—" Connecting and bracing the folding portions and intermediate legs by the double cog hinges attached to the side rails, and having their bearings in the intermediate posts."

130. For an *Improved Gearing for Wagons;* Edgar Hudson, Ithaca, New York.

Claim.—" So making the frame as to leave the forward extremities of said frame open, so as to receive the pole or thills between and back of the forward ends of the side springs—thus bringing the animal nearer the wagon, and thereby making the draft easier, and requiring less room in which to turn."

131. For an *Improved Brick Press;* Samuel Lillie, Jr., Fort Wayne, Indiana.

Claim.—" Forcing the clay into the moulds, and compressing it therein by means of a hollow plunger, fitted and working within the box, and connected with the platform on which the moulds are placed, so that the plunger and mould to be fitted rise and fall together."

132. For an *Improvement in attaching Extra Topsails to Vessels;* E. H. Linnell, Orleans, Massachusetts.

Claim.—" Attaching and hanging the extra topsail yard to the topmast itself, by means of the combination of the collars, and turning on the topmast the forked brace connecting said collars, and the stationary annular plate on which the lower collar rests and turns, so that said extra topsail yard shall swing from the axis of the topmast as a centre."

133. For an *Improvement in Gas Retorts;* Michael J. Miller, St. Louis, Missouri.

Claim.—" The pipe inserted so as to receive the gas at the bottom of the retort."

134. For *Improved Machinery for Excavating Rock;* Jesse C. Osgood, Troy, N. Y.

Claim.—" 1st, Excavating rock under water by means of the wedge-shaped chisel, whose length is greater than the depth of water. 2d, The spring head, or its equivalent, in combination with the chisel. 3d, The arrangement of the spring within the loop or strap of the turn buckle, in combination with the sliding nut."

135. For an *Improved Mode of Fastening Skates;* Henry Pickford, Boston, Mass.

Claim.—" Uniting the skate blade to the sole of the boot or shoe."

136. For an *Improvement in Self-disengaging Car Coupling;* Joshua C. Price, New Philadelphia, Ohio.

Claim.—" The employment of two obliquely set sliding head blocks, stop bars, connected by a turning link or plate, which is hollowed out and beveled inward on each of its edges, in combination with the hinged buffer pin plate, which is furnished with two outwardly beveling projections on its under side, said parts being arranged relatively to the buffer head."

137. For an *Improved Device to Allow Circular Saws' end play Independently of the Driving Shaft;* Wm. S. Reeder, St. Louis, Missouri.

Claim.—" The arrangement and combination of an additional driving-shaft, with the shaft that carries the saw."

138. For an *Improvement in Boat Oars;* Rufus Rode, Manchester, Pennsylvania.

Claim.—"The means by which I back water when the oar is to be used for that purpose, the oar to return to its place when feathering by means of lever, fulcrum, and springs."

139. For an *Improvement in Manufacturing Spinning Flyers;* John N. Sawtell, Lowell, Massachusetts.

Claim.—"The manufacture of flyers casting on the polished arms, the neck or nozzle, of metal, when the former are prepared by the application of a proper composition, so as to render the adherence of the nozzle to the arms secure."

140. For an *Improvement in Machinery for Harvesting Grain and Grass;* William and Thomas Schnebly, Hackensack, New Jersey.

Claim.—"The thin trapezoidal shaped finger or guard, in combination with the cutters, when said finger is constructed with an open area or space, conforming to the same finger, and with recesses in front and rear to support and guide the cutters near the centre of the finger or guard."

141. For an *Improved Machine for Splitting Shoe Pegs;* Nathaniel H. Shaw, Farworth, New Hampshire.

Claim.—"The feeding blade, whereby its movement is produced and adjusted to suit all the requirements of the machine, under all circumstances, in the most simple and perfect manner. Also, the arrangement of the holding bar in such a manner as to enable its motions to be produced without interference with alternate action of the splitting knife and feeding blade, and to be adjusted for the different sizes of pegs, so as not to disarrange the relative positions and movements of said holding bars, splitting knife, and feeding blade."

142. For an *Improvement in Harness for Horses;* Joseph Smith, Delaware, Ohio.

Claim.—"1st, The said bars, connected by cross-bar, or their equivalents. 2d, Pads or their equivalents. 3d, Triangular couplings, or their equivalents."

143. For an *Improved Mode of Securing Hubs on Axles;* Alfred E. Smith, Bronxville, New York.

Claim.—"The mode of securing the pipe box and hub on the axle, by forming the inner end of the pipe box with a flanch fitted to enter a recess in a collar fitted and secured into the inner end of the hub, when this is combined with a projecting collar on the axle, and a loop ring on the axle, and the collar on the hub being connected by turn buttons, or equivalents."

144. For an *Improvement in Feed-water Apparatus to Steam Boilers;* Andrew J. Vandegrift, Delaware, Ohio.

Claim.—"The fourth valve and the escape pipe."

145. For an *Improved Machine for Fitting Gas Pipes;* Caleb C. Walworth, Boston, Massachusetts.

Claim.—"The coupling constructed with long, short, and inclined faces."

146. For an *Improvement in Damper Regulators for Steam Boilers;* Wm. Webster, Morrisania, New York.

Claim.—"The arrangement of the several parts.

147. For an *Improvement in Electric Telegraphs;* Wm. D. Wesson, Chilicothe, Ohio.

Claim.—"Constructing the stationary telegraph line of a series of immovable and interposed movable conductors, and furnishing the vehicle with a circuit breaker, circuit receivers, and conductors, arranged to operate for the purpose of breaking the circuit through the main line, at a point or points where the vehicle is passing and completing the circle through, so that by suitable telegraphing instruments or apparatus carried by the vehicle, communications may be transmitted and received by the vehicle to and from other vehicles, or to or from stations at a distance, either while the vehicle or vehicles are stationary or in motion."

148. For an *Improvement in Machines for Paring Apples;* David H. Whittemore, Worcester, Massachusetts.

Claim.—"1st, Giving the slide (with its slicing knife attached,) a curved or lateral motion for the purpose of enabling the slicing knife to leave the core in a shape for the easy removal of the apple. 2d, The arrangement consisting of the traveling knife carriage, with its tilting lever playing over the guard, which keeps the lever engaged with the screw while the apple is being pared, and releases it for the free return of the carriage."

149. For an *Improvement in Machines for Cutting Vegetables;* H. A. Willard, Westminster, Vermont.

Claim.—"The cutter, in combination with the metallic cutter plate, together with the particular arrangement of the cutters upon the cutter plate in such a manner that several are acting upon the vegetable at the same time, and that as soon as one has commenced another immediately follows, so that while a portion are leaving the vegetable and holding it firmly to the plate, others are commencing, preventing by this arrangement the vegetable from rolling or dodging, and keep it continually in contact with the knives, thereby cutting with greater rapidity with less power, and leaving the cut vegetable in a more desirable shape for mastication than any machine now in use."

150. For an *Improvement in Operating Valves for Steam Engines;* Samuel R. Wilmot, Watertown, Connecticut.

Claim.—"The valve motion for operating the valves of steam engines, and consisting essentially of a twisted traverse rod of a traveling slide, and of the stops which limit the turning of the slide, or their equivalents."

151. For an *Improved Method of Raising Water;* Daniel K. Winder, Cincinnati, Ohio.

Claim.—"The arrangement and combination of annular reservoir, with the plunger, tube, flexible pipe, valves and cock."

152. For an *Improvement in Boot Crimping Machines;* J. G. Baker, Jr., Assignor to self, and Charles Bradfield, Philadelphia, Pennsylvania.

Claim.—"The combination of the swiveled stay-rods, with their cross-heads and thumb-screws, when arranged with the former for the purpose of facilitating the removal of the finished boot front, and introduction of another piece."

153. For an *Improved Sash Fastener;* Thomas Floyd, Assignor to self, and G. H. Merkline, Chambersburg, Pennsylvania.

Claim.—"The triangular or catch lever, and thumb lever, in combination with the cylinder, the follower with piece attached, and spring."

154. For an *Improved Tile Machine;* Junius Foster, Assignor to self, John Herbold, and George Kuhn, Brooklyn, New York.

"The nature of my invention consists in supplying clay to a pair of rollers or rolling die, by means of a plunger that presses into and through said rollers, and then said rollers remain stationary at the time the plunger recedes to take a fresh supply of clay from the hopper, and simultaneously the tile is cut off while stationary, ready to be taken away for drying."

Claim.—"The combination of the reciprocating plunger, with the rollers, slide or trough, and knife or wire, when the said parts are arranged for joint operation."

155. For an *Improvement in Curtain Fixtures;* Lewis B. Cushman, Assignor to self, Henry W. and Henry Safford, Philadelphia, Pennsylvania.

Claim.—"The use of the lever, when the said lever is caused to operate upon the bracket in supporting a window curtain by means of the upward strain of the cord."

156. For a *Varnish Can;* Alonzo Marshall, Assignor to Benjamin Marsh, Newark, New Jersey.

Claim.—"Connecting the two vessels by a pipe."

157. For an *Improved Mode of Securing to each other the Panels of Field Fences;* C. P. Garlick, Amador, Minnesota Territory, and G. M. Blackstone, Mainville, Ohio.

Claim.—"The combined uses of the mortises and wedges in the chair, when arranged with, and used for, connecting the lower part of the panels of the fence together."

FEBRUARY 24.

158. For an *Improved Keeper for Right and Left-Hand Door Locks;* Calvin Adams, Oak Hill, New York.

Claim.—"The use of a beveled keeper, when employed in connexion with a double-faced lock, having a blunt bolt, so that the lock may be used on a right or left-hand door, without changing any of its parts."

159. For an *Improvement in Hand Seed Planters;* John H. Bruen, Penn Yan, N. Y.

Claim.—"The thin broad extremity, or its equivalent, at the lower end of the rod, acting as a cam to open the blades, by giving said rod a partial turn with the hand. Also, in combination with the above, the arrangement of the seed distributor on the rod, whereby the seed is made to drop simultaneously, and only with the opening of the blades. Also, the star or coral shaped attachment of the rod, operating so as to insure the regular action of the seed distributor."

160. For an *Improvement in Hinges;* John David Browne, Cincinnati, Ohio.

Claim.—"Making one part of the bearings of a hinge concentric to the other part."

161. For an *Improvement in Grinding the Inner Surface of Cast Iron Kettles;* Christopher C. Bradley, Jr., Syracuse, New York.

Claim.—"The arrangement of the revolving shaft, vertical fans, and the grindstones, with respect to the kettle, when the grindstones operate upon successive portions of the kettle by a change of velocity in the shaft."

162. For an *Improved Cauterizing Syringe;* Erastus T. Bussell, Shelbyville, Indiana.

Claim.—"The combination of hollow plunger with cauterizing rod encased, and divergent spring fingers, with absorbent bulbous extremities, all connected with cylindrical tube."

163. For an *Improved File Cutting Machine;* Isaac H. Coller, Poughkeepsie, N. Y.

Claim.—"As an improvement on the mode patented by Conklin, Sidman, and Whritner, the jointed frames, for transmitting the graduated effect of the springs to the hammer, so that the rods holding said springs will not vibrate from the movement of the hammer. Also, the combination of the lever-jaws, with the spring tang holder."

164. For an *Improvement in Combining Hydrogen and Wood Gas;* Warren C. Choate and Charles N. Tyler, Washington, D. C.

Claim.—"Combining hydrogen gas with the gaseous products evolved from the dry distillation of wood."

165. For an *Improvement in many Chambered Rotating Breech Fire Arms;* Samuel Colt, Hartford, Connecticut; patented in England March 3, 1853.

Claim.—"Making the series of grooves to be acted upon by the driving pin, to rotate and hold the breech in a concavity in the rear end of the rotating breech."

166. For an *Improved Elastic Cap for Sealing Cans and Bottles;* Rhoda Davis, Brookhaven, New York.

Claim.—"A cap or cover for sealing vessels, composed of india-rubber."

167. For an *Improvement in Gig Mills for Napping Cloth;* Ernest Gessner, Aue, Saxony.

Claim.—"1st, The arrangement of the parts of the machine, whereby it combines the properties of napping the cloth while it is continually moving over the surface of the napping cylinder, of holding the cloth stretched in the direction of its breadth, of presenting the cloth to the napping cylinder in such manner that the face which receives the nap is exposed to view, and of operating on the cloth at several points of contact at the same time. 2d, The arrangement of the four guide rollers, so as to be simultaneously adjusted by screws, or their equivalents, applied to their bearings to bring the cloth into more or less intimate contact, or with a greater or less surface in contact with the napping cylinder."

168. For an *Improved Apparatus for Supplying the upper stories of Houses with Water;* Thomas Hanson, City of New York.

Claim.—"The combination of a hydraulic engine, with, and interposed between, the supply pipe from the street main, receiving water from a head, and the house pipe or pipes, and cock or cocks, for supplying water to the lower story or stories of a house by the force of the said head, and the pump operated by the said engine, and receiving water from the same head, discharging it into a reservoir or reservoirs for the supply of the upper stories of the house."

169. For an *Improvement in Marking Slates;* John W. Hoard, Providence, Rhode Island.

Claim.—"I do not claim liquid quartz itself for producing indurative surfaces for marking upon: but I claim it as the vehicle for manufacturing artificial marking or writing slate, when combined with oxyd of zinc, as a drying anti-deliquescent and coloring substance."

170. For an *Improvement in Casting Skeins for Wagons;* Andrew Leonard, Kenosha, Wisconsin.

Claim.—"The method of moulding and casting thimble skeins, and other hollow conical castings in a vertical position from whole patterns, leaving their own cores of green sand, which were moulded in the hollow of the patterns, around one end of long core bars, so arranged and combined with the cores and with the solid sand in the flask, as to have the other end of the same bars sustain the core, or to render them adjustable by hand, after the patterns are withdrawn and the mould completed, and of thus ensuring the true position of the cores in the centre of their moulds, and making the casting perfectly true and seamless direct from the sand."

171. For a *Photographic Glass-holder;* Joseph Longking, Township of New Windsor, New York.

Claim.—"A photograph holder, composed of antimony, tin, and lead, alloyed in the proportions set forth."

172. For an *Improvement in the Manufacture of Iron and Steel;* Joseph C. Martien, Newark, New Jersey.

Claim.—"Subjecting the molten iron to the action of atmospheric air, steam, or other gaseous body, or chemical agents, in any form capable of evolving oxygen or other purifying gas, in such manner as to cause the air, steam, or other solid liquid or gaseous body, to impinge upon, penetrate through, or search among, the metal while it is flowing or in a state of transit through a trough or conductor, or other place."

173. For an *Improved Calk for Horse Shoes;* Edward Maynard, Williamsburg, New York.

Claim.—"The conical or tapering body of the calk, fitting a corresponding shaped hole in the shoe, in which it is retained by the screw, or its equivalent."

174. For an *Improvement in Iron Pavements;* Charles Mettam, City of N. York.

Claim.—"Casting each block or plate, with a number of hooks standing out laterally from below the general level of the bottom thereof, and turning upwards in the form of vertical tenons, and with a corresponding number of mortises in the lower faces, so that when the plates are laid together, the vertical tenons of one block or plate enter mortises in adjacent ones, and the mortises receive tenons of adjacent ones, while the laterally projecting portions of the blocks or plates make them mutually supporting."

175. For an *Improvement in Steam Boilers;* Jason J. Palmer, Flushing, New York.

Claim.—"The particular arrangement of the flues close to the fire shell of the boiler, and admitting only a thin but continuous sheet of water between them and the fire shell —this thin sheet of water also connecting freely at top and bottom, with the main body of water in the boiler—by which arrangement a more rapid and complete circulation is produced, this thin sheet of water being constantly forced towards, and in contact with, the sides and crown of the fire shell, *i. e.*, the hottest parts of the boiler, and thus heated more rapidly and made to circulate the faster. Also, the arrangement of the perforated plate, it being interposed between the furnace and low exit into the smoke box or stack."

176. For an *Improvement in Cordage Machines;* James Pine, Hoosick Fall, N. Y.

Claim.—"1st, The additional flyers carrying the stretching rollers, arranged relatively to the main flyers, and deriving motion in the same direction as the said flyers, but at a less velocity, and operating to stretch the strands after they have received the usual twist, and to impart an additional twist to compensate for the reduction of twist by stretching. 2d, The device for producing an uniform tension on the strands by friction upon the strand bobbins, consisting of the elastic curved lever, or combined lever and spring, attached by a fulcrum pin to the flyer-frame, and operating on one head of the bobbin, and upon the surface of the outer coil of yarn or strand on the bobbin."

177. For an *Improved Saw Filer;* Archibald Robbins, Alanson Shewman and L. R. Bigelow, Watkins, New York.

Claim.—"The combination and arrangement of the sliding carriage, the index-wheel, arc adjuster, and guide frame."

178. For an *Improvement in Floating Sectional Dry Docks;* John Seely, Buffalo, New York.

Claim.—"1st, The combination of the conducting pipe with the tubular hinges and sectional dock. 2d, The combination of the parallel braces (turning upon joints) with the floating docks and the wheel pit."

179. For an *Improved Saw-Set;* Joseph D. Spiller, Concord, New Hampshire.

Claim.—"Combining the gauge and bearing screw in one movable frame, applied to the lower jaws, and furnished with a set-screw."

180. For an *Improvement in Grain Separators and Straw Carriers;* Cornelius Van Derzee, Albany, New York.

Claim.—"The method of agitating and moving the straw, for the purpose of separating the grain from it by rungs of spokes, rotating in connexion with each, or in reference to each other's movements."

181. For an *Improvement in Manufacturing Ribs for Cotton Gins;* John W. Webb, Cotton Valley, Alabama.

Claim.—"The new manufacture of cotton gin ribs, that is to say, ribs of cast iron, with two places chilled upon them in casting, while the rib is so formed that the ends may be reversed in the same breast of the gin, so that when one chilled part of the rib is worn out, the other may be brought to the working point of the gin saw, and thus effect an important economy in the construction of cotton gins."

182. For a *Solar Camera;* David A. Woodward, Baltimore, Maryland.

Claim.—"Adapting to the camera obscura a lens and reflector, in rear of the object glass, in such manner that it is made to answer the two-fold purpose of a camera obscura and camera lucida."

183. For an *Improved Method of Hanging the Sieves of Grain Separators;* Benjamin Wright, Hudson, Michigan.

Claim.—"The use of an adjustable pin and hooked stop plate."

184. For an *Improved Metallic Lathing;* Wm. E. Worthen, City of New York.

Claim.—"Corrugated metal, provided with tongues slit out of the body thereof, and bent away from their original position, and constituting as a whole an article to be used in building. Also, such tongues, formed substantially in such a manner, on and out of corrugated metal when they are dished or concaved."

185. For an *Improvement in Shoving-poles for Steamboats;* D. Cumming, Jr., Assignor to D. Cumming, Sr., Mobile, Alabama.

Claim.—"The combination of a shoving-pole or rod directly with the piston of a portable or movable steam cylinder."

186. For an *Improved Device to operate the Mandrel-Cutters in Turning Tapering Sticks;* Peter H. Niles, Assignor to self, Nehemiah Hunt, Ralph C. Webster, and Alfred Douglas, Jr., Boston, Massachusetts.

"The invention consists, firstly,—of a hollow arbor, which is capable of being revolved in suitable bearings, to one end of which a chuck is attached, which carries a cutter and also three movable radial jaws, whose office is to steady the work. 2d, Of a cam, which moves the jaws towards and from the axis of the arbor, while the work is passing through the said arbor. 3d. Of a chain or belt, provided with projections or dogs, for carrying the work to the cutter."

Claim.—"The method of operating the cutters of a revolving cutter-head, viz: by means of the springs, inclined planes, and the sleeve operated by a cam."

187. For an *Improvement in Preparing Alkaline Silicates;* John M. Ordway, Assignor to the Roxbury Color Chemical Manufactory, Roxbury, Massachusetts.

Claim.—"The manufacture of soluble silicates of soda or potash, from the sulphates of soda or potash, by fluxing the same with silica and deoxidizing agents."

RE-ISSUES FOR FEBRUARY, 1857.

1. For an *Improvement in Mode of Driving Reciprocating Saws;* Isaac Brown, Baltimore, Maryland; patented July 14, 1853; re-issued Feb. 3, 1857.

Claim.—"The mode of applying the power of the engine to the saw or frame, without being permanently connected therewith, so that the piston shall be in a great measure relieved from any lateral motion which the gate may have, which causes it to bind or cut in the cylinder. Also, driving one or more saws between two cylinders, as well as driving one or more saws on each side of a single cylinder, and the self-adjustable piston-rod, or the self-adjustable slides, which accomplish the same result."

2. For an *Improved Raking Attachment for Reapers;* Moses G. Hubbard, Penn Yan, New York; patented September 2, 1856; re-issued Feb. 3, 1857.

Claim.—"The combination of the jointed rake arms, with the disk by which the arm is actuated, when the above parts are constructed and arranged for joint operation."

3. For an *Improvement in Machines for Pressing Bonnets and Bonnet Frames;* Wm. Osborn, Louisville, Kentucky; patented August 19, 1856; re-issued Feb. 17, 1857.

Claim.—"Pressing the whole of a bonnet or bonnet frame, including the flaring face piece, side crown, and tip, at one operation, by dies, whether said bonnet or frame be formed of one or of several pieces, and irrespective of the particular shape of the bonnet or frame. Also, forming the side crown and flaring face piece of a bonnet frame in one piece, or at one operation."

4. For an *Improvement in the Manufacture of Hosiery;* Wm. H. McNary, Brooklyn, New York; patented December 23, 1856; re-issued Feb. 17, 1857.

Claim.—"The production of the heels and toes of hosiery, by knitting a piece of spherical or other suitable form, on the cylindrical or straight portions of the leg or foot, by any mode of operation in which the stitches are dropped or left upon the needles and taken up again, whereby the whole of the leg and foot is enabled to be produced by a continuous operation of the machinery or devices employed."

5. For an *Improved Machine for Making Clothes Pins;* George W. Parker, Fitzwilliam, New Hampshire; patented March 18, 1856; re-issued Feb. 17, 1857.

Claim.—"1st, The use of holes in a wheel, or of tubes secured to a wheel, and into which the pieces of cloth are fed, and are thus retained in, and moved forward to, the right position to be acted upon by the lathe, saw, or bit. 2d, The sliding or vibrating lathe and tail-block, whereby the pieces of wood to be turned are carried forward to the action of the cutters or chisels. 3d, The cutters or chisels, in combination with the lathe. 4th, A holder, to hold the pieces while being sawed or bored, the succeeding piece forcing the preceding one out of the holder, and it drops between the holder and saw or bit; and whether the holder be movable or stationary, the saw or bit being made to move to and from the holder, or the holder be made to move to and from the saw or bit. 5th, a saw or bit, either movable or stationary, in combination with the holder. 6th, A punch, or its equivalent, to force the pieces into the holder."

6. For a *Bituminous Ground for Photographic Pictures;* V. M. Griswold, Lancaster, Ohio; patented October 21, 1856; re-issued Feb. 24, 1857.

Claim.—"'Sensetized bitumen' prepared for the purpose of taking photographic impressions on paper, metallic sheets, or other structure."

7. For an *Improvement in the Mode of Constructing a Combined Cauldron and Furnace for the use of Agriculturists and others;* Jordan L. Mott, Mott Haven, New York; patented Dec. 1, 1840; extended Dec. 1, 1854; re-issued Feb. 6, 1855; re-re-issued Feb. 24, 1857.

Claim.—"Combining a cauldron with a small, square, or rectangular box stove of less area than the cauldron, by spreading out the upper part of the box stove to a circular form to surround the cauldron by a flue space. Also, making the casing to form a flue space around the cauldron, by the elevating and spreading the plates of the stove, in combination with sectional side pieces."

8. For an *Improvement in Looms for Weaving Pile Fabrics;* Erastus B. Bigelow, Boston, Massachusetts; patented November 15, 1853; re-issued February 24, 1857.

Claim.—" 1st, The method of constructing and operating the pincers, or other equivalents, for successively operating the pile, so that they shall carry said pile wires forward to the fell of the cloth, and hold them in position with their proper edges upwards until they are otherwise secured. 2d, Constructing the pincers for successively operating the pile wires with grooved jaws opening and closing in a line with the pile wire, and within advance of the lathe. 3d, The employment of a support or guide to successively receive the inner ends of the pile wires as they are drawn from the cloth, and carry them to the position where they are to be introduced into the shed of the warps, and guide them therein. 4th, The employment of long horizontal guides to guide the pile wires as they are being inserted in the shed of the warps. 5th, Holding the pile wires and guiding and adapting the pincers, or their equivalents, to a suitable position to engage therewith. 6th, In combination with the pile wires, a bar or guide, which shall successively press against said pile wires to keep them in a proper position during the operation of cutting the pile. 7th, The method of applying the tension weight and brake directly to the whip roller by means of the arms."

DESIGN FOR FEBRUARY, 1857.

1. For *Wood Stoves;* A. C. Barstow, Providence, Rhode Island; February 17, 1857.

Claim.—" The new design for a stove, consisting of the ornamental configuration."

MARCH 3.

1. For an *Improvement for Sustaining Friction-rollers in Ship Blocks;* John Allender, City of New York.

Claim.—" The pieces placed between the rollers, in combination with the flanches, or their equivalents, to hold the rollers in position endwise, and permit them to revolve, thereby dispensing with the pivots and rings."

2. For an *Improvement in Casting Plates for Artificial Teeth;* Alfred A. Blandy, Baltimore, Maryland.

Claim.—" Moulding the plates of artificial teeth in such a manner as to obtain a perfect fit to the gums, and a correct 'articulation' of the teeth upon casting."

3. For an *Improvement in Compositions for Shuttle Drivers;* Samuel Boorn, Lowell, Massachusetts.

Claim.—" Composition to be used in the manufacture of the striker of a shuttle driver."

4. For an *Improvement in Sewing Machines;* Charles D. Belcher, Charleston, South Carolina.

Claim.—" The improvement on the patents of A. B. Wilson, consisting in the application of an unyielding brake to hold the loop upon the revolving hook, and imparting a positive movement thereto, in such a manner as to separate it from, and bring it to, the periphery of the hook at the proper moment."

5. For an *Improved Pen and Pencil-Holder;* George Hunt Byron, Governor's Island, New York.

Claim.—" The attachment of the handle of the holders to a diagonal expanding frame, and the general arrangement. Also, the handle and the arms, working by pins in slots in the attached holders, and secured by thumb-screws to the handle. I do limit myself to any number of holders, which may consist of any required number. Also, its application by attaching pens known as 'music pens,' instead of the ordinary writing pens, for ruling several staves of music at one operation."

6. For an *Improved Hand Stamp;* Leonard Bailey, Winchester, Massachusetts.

Claim.—"Arranging an ink fountain and its discharging roller at the foot of the slider, and between the same and the type or printing plate, and so as to be movable. Also, arranging the forked lever of the inking roller, with respect to the slider, so that while the palm of a person's hand is placed on the top of the slider, one or more of the fingers can operate said lever or the upper arm thereof, in a manner to move the inking roller backwards against the type, and into a position to come in contact with the fountain roller, when the slider is next depressed."

7. For an *Improvement in Sewing Machines;* Joseph W. Burnham, Hartford, Conn.

Claim.—"The employment on sewing machines of the mechanism, so as to cut or clip the thread on the underside of the work."

8. For an *Improvement in Trip Hammers;* Henry Bushnell, New Haven, Conn.

Claim.—"The use of the male and female wheels, having a portion of the surface of either one of them removed, so as to permit the hammer to drop freely."

9. For an *Improvement in Washing Machines;* Richard Collins, Chicopee, Mass.

Claim.—"Combining with, and arranging in, the vibratory dasher, one or more soap receptacles or chambers, each provided with an aperture of discharge, and a stop-cock or faucet, or the equivalent therefor."

10. For an *Improvement in the Mode of Lubricating Fire Arms;* Samuel Colt, Hartford Connecticut.

"The nature of my invention consists in applying lubricating matter in the barrels of fire arms, after the ball has been inserted, whether such lubricating matter has been applied to the outer surface of the ball or the inner surface of the barrel, by means of which the fouling of the barrel by the ball is effectually prevented, and the passage of the ball in the discharge greatly facilitated, while at the same time the lubricating matter will be prevented from reaching the charge of the powder."

Claim.—"The method of applying oil, or other lubricating matter to the outer surface of the ball, or as the equivalent to the bore in close proximity with the ball, after the ball has been inserted by means of an instrument having a reservoir of liquid lubricating matter, in combination with a valve, or other equivalent means for discharging the required quantity of lubricating matter."

11. For an *Improvement in Churns;* E. P. and J. A. Cowles, Oakfield, New York.

Claim.—"The shafts, with collars and wheels, in combination with springs."

12. For an *Improved Hand-Printing Press;* Nathaniel L. Chamberlin, West Roxbury, Massachusetts.

Claim.—"1st, The method of hanging and balancing the impression roll. 2d, The method of adjusting the impression roll to increase or diminish the pressure given and adapt it to the size of the form and the height of the type or block."

13. For an *Improved Machine for Cutting Paste-board for Boxes;* Eliezur E. Clarke, New Haven, Connecticut.

Claim.—"1st, The method of attaching and adjusting the cutters, in combination with the main cylinder. 2d, The combination of the spring clamps with the main cylinder and cutters."

14. For an *Improvement in Sheep Shears;* Edward G. Chambers, Bucyrus, Ohio.

Claim.—"The fixed plate stock, combined with the bifurcated handle of the vibrating cutters."

15. For an *Improvement in Harvesters;* Stillman A. Clemens, Rockford, Illinois.

Claim.—"The method of operating the sickles of harvesters by means of a catch-wheel, a spring and a recoil cushion, connected, combined, and attached."

16. For an *Improvement in Potato Diggers;* Paul Dennis, Stillwater, New York.

Claim.—"In combination with the diggers constructing the separator, so as to form an irregular undulating surface for the potatoes to fall upon."

17. For an *Improved Method of Suspending Wind-Wheels in Self-revolving Adjusting Frames;* Joseph de Sendzinner, South Oyster Bay, New York.

Claim.—"Suspending the wind-wheel within a revolving frame."

18. For an *Improvement in Making Tire for Railway Car Wheels;* James Evans, Portsmouth, Ohio.

Claim.—"The use of the rings, in connexion with the segments of iron, the same being cut, and piled, and prepared for forging, for making tire for railroad car wheels, locomotives, and other purposes."

19. For an *Improved Circular Sawing Mill;* Philander Eggleston, Mobile, Alabama.

"The invention consists in suspending the log to the carriage, or attaching it to the under side of the carriage by means of hooks and dogs, and also the two saws and feed movement, when used in connexion with the log suspended to the carriage."

Claim.—"1st, Suspending the log to the carriages by means of the bars, and arranged with the screw-rods and shafts, whereby the log may be firmly dogged or secured in proper position, and also adjusted, or elevated, or depressed to the desired position or height. 2d, Suspending the log from the carriages, as shown, in any proper mannner, in combination with the two saws and the feed movement, composed of the shafts, with their respective pulleys, and belts, and the clutch."

20. For an *Improvement in Machines for Harvesting Standing Corn;* James H. Frampton, Hopewell, Ohio.

Claim.—"The body, so arranged that it may be operated to discharge the stalks, in combination with the rods placed in said body, and provided with curved ends or griping arms."

21. For an *Improvement in Chronometer Escapement;* James Fulton, Louisville, Kentucky.

Claim.—"The combination of two levers, in such a way that one spring may perform the offices by acting on both of them."

22. For an *Improvement in Bridge Trusses;* Albert Fink, Parkersburg, Virginia.

"My improvement consists in the use of an auxiliary truss, between the main supports of a truss, commonly known under the name of Howe's truss."

Claim.—"The use of an auxiliary truss, which is to consist of the lower part of the counter-brace, and of a piece placed between the two main braces, independent of these braces."

23. For an *Improvement in Seed Planters:* Firman Goodwin, Astoria, New York.

Claim.—"Arranging the seed hoppers and seed cylinders, and the mechanism which operates the seed cylinders, upon movable bars, in combination with the double crank and frame."

24. For an *Improvement in Harvesters;* Lewis W. Harris, Waterville, New York.

Claim.—"1st, In combination with the alternately projecting lags, the rocking shafts, with their toe pieces, cranks, and connecting rod, for the purpose of operating the cutters. Also, hanging the shafts in the hinge pieces, when said hinge pieces are put within the control of the conductor, by means of the rods and treadle, or their equivalents, so that he may, from his seat, throw the cutters into and out of gear."

25. For an *Improved Hand-Stamp;* Horace Holt, Winchester, Massachusetts.

Claim.—"The combination of a detached lever, with its toe pieces for inking and taking the impression, when said inking and impressing devices are returned to their places by springs."

26. For an *Improvement in Machines for Making Axes;* Charles Hutchins, East Douglass, Massachusetts.

Claim.—"The preparation of the bar or block of iron, by longitudinal rolling between rolling dies, operating to form it with a projection on one face into the middle of its length, and two projections on the opposite face, one at each end, in combination with the cross rolling between segment dies, under a mode of operation to reduce the thickness of the cheeks towards the edges, and to the required swell on the edges of the cheeks."

29. For an *Improved Screw Wrench;* B. F. Joslyn, Worcester, Massachusetts.

Claim.—"A hammer shank, with a thread on both edges fitting into a nut, when combined with the other parts of the wrench."

28. For an *Improvement in Weavers' Shuttles;* Lucius J. Knowles, Warren, Mass.

"My improvement or invention consists in a means of causing a loom to stop its motion or weaving operation, on the breakage of the thread leading from the bobbin of the shuttle."

Claim.—"The combination of the tilting lever, the inclined wires (or the equivalent of the latter), and a spring cam, or means essentially the same as said spring cam, whereby in case of breakage of the thread from the shuttle, while the latter is in motion across the race beam of the lay, the cam or contrivance to operate the protector may be caused to so act with or against such protector, or its equivalent, that it shall be made to produce stoppage of loom as stated."

29. For an *Improved Raker for Reaping Machines;* Caleb Lee, Knox Township, Ohio.

Claim.—"The two spring latches working upon the arm, in combination with the pointed lever, the latches being notched to receive the same; and both the lever and latches being arranged so as to be acted upon alternately by pins, to raise or lower the rake and hold it in either position as required."

30. For an *Improved Basin Cock;* Robert Leitch, Baltimore, Maryland.

Claim.—"The arrangement of the loose stop-piece, constructed with a male screw thread on the periphery, and the means for operating it vertically without turning, by the fixed square on the stem, and a corresponding female screw-thread, or its equivalent, in the rotating globe of the cock."

31. For an *Improvement in Machines for Husking Corn;* Wm. Lewis, Seneca Falls, New York.

Claim.—"The bar, knife, bar or hammer, and stop, in combination with the clearing rod, when the whole are arranged to operate conjointly."

32. For an *Improved Photographic Plate-holder;* Wm. and Wm. H. Lewis, City of New York.

Claim.—"1st, Constructing the hollow base and hub of the cap-plate in such a manner as to receive the friction spring, screw, and cap, for regulating the power with which said plates are clamped together. 2d, Regulating the force with which the spring tends to clamp any glass or holder between the jaws, and by means of the set-screw. 3d, The beveled adjustable bars on the jaws, to support the glasses, plates, or holders, with their upper surface at the desired height above the upper edges of the said jaws."

33. For an *Improvement in Mastic Roofing Compounds;* Charles R. Milks, Detroit, Michigan.

Claim.—"The composition for roofing made up of the ingredients."

34. For an *Improvement in Machines for Husking Corn;* John Massey, Buffalo, New York.

Claim.—"The tapering tubular burr, for the purpose of removing the husks from the corn."

35. For an *Improvement in Curtain Rollers;* Purches Miles, Hartford, Conn.

Claim.—"The combination of the toothed flanched pulley, the endless eyelet band, and the friction spring with the roller."

36. For an *Improved Shingle Machine;* H. D. McGeorge, Morgantown, Virginia.

Claim.—"In combination with the saw and carriage, the rocking bed for determining and adjusting the bolt to the thickness and taper of the shingle to be sawed."

37. For an *Improvement in Machines for Composing Types;* Wm. H. Mitchel, Brooklyn, New York.

Claim.—"The manner of dropping one type at a time from the lines of types in the conductors, by the combined operation of the pushers, stop, and fingers. Also, the composing wheel when used in connexion with the inclined chute or conductor and fence, on the lower side only of the inclined composing wheel. Also, the compositor's grab formed in the curved shape."

38. For an *Improvement in Machinery for Grinding Card Cylinders;* Jonathan Parker, Biddeford, Maine.

Claim.—"The combination of the stop motion or mechanism, or the feed mechanism, or that which produces the reciprocating traverse motion of the grinder."

39. For an *Improvement in Sewing Machines;* Samuel F. Pratt, Roxbury, Mass.

Claim.—"Producing successive corrugations or folds in the cloth, for the purpose of feeding the cloth for the production of the stitches. Also, the combination of the lifter spring, the nipper spring, the rod, and flattening spring, they operating together and upon the cloth."

40. For an *Improved Machine for Beveling and Jointing Staves;* Erastus M. Pitman, Warren County, Virginia.

Claim.—"The combination of the reciprocating plane, having reversed bits and the motion referred to, and the carriage with the inclined ways."

41. For an *Improvement in Generating Steam;* Charles F. Pond, Hartford, Conn.

Claim.—"The method of generating steam from water, introduced in numerous fine jets, and thrown upon heated metallic surfaces, when this is combined with the heating of the said metallic surface on which the jets of water are to be thrown, to be evaporated by the contact of steam, generated in a separate boiler, connected therewith, for circulation and other purposes."

42. For an *Improvement in Centrifugal Friction Clutch;* Rensselaer Reynolds, Stockport, New York.

Claim.—"The employment in the combination of the sector friction brakes, sliding radially in the wheel or pulley which rotates before the clutching takes place, and usually termed the loose pulley, that the other wheel or fast pulley may be clutched by the friction of the brakes due to the centrifugal force generated by the rotation, and by which they are forced onward against the inner periphery of the wheel to be clutched, thereby clutching the parts by a force no greater than that due to the friction produced by the centrifugal force under the determined proportions, weight, and rotative velocity of the friction brakes."

43. For an *Improvement in Locks;* J. Christian Riethmüller, Pittsburgh, Pennsylvania.

Claim.—"The peculiar arrangement of the tumbler plates in the box, viz: the tumbler plates projecting and receding alternately sidewise, their guiding grooves in the box being made accordingly deeper and shallower alternately, and also separating the tumbler plates by a small space—this whole arrangement of the plates being for the purpose of allowing each spring to act on its respective tumbler plate freely, without interfering with or disturbing the free play and action of the plates or springs adjoining. Also, the providing of one of the tumbler plates with the tongue and the recesses in the bolt tumbler, operating together for the purpose of securing the bolt tumbler in its position when the lock is in its locked or unlocked state. Also, the combination of the key and bit plates."

44. For *Improved Soap Mixtures;* Isaac Roraback, Parish of Caddo, La.

Claim.—"The compounding of them in such proportions as to form a solid of suitable consistency, which I believe excels any other soap in its suitableness for cleansing clothes of every description, and for toilet purposes generally, as well as in point of cheapness and conveniency, and dispatch with which it is made."

45. For an *Improvement in Washing Machines;* Louis C. Rodier, Detroit, Michigan.

Claim.—"The revolving cylinder composed alternately of flanches and spaces opposite said flanches, in combination with the jacket."

46. For an *Improvement in the Manufacture of Tin Pans;* E. F. Parker and J. Smead, Proctorsville, Vermont.

Claim.—"A milk pan with a struck up bottom, and united to the side."

47. For an *Improvement in Projectiles;* Malcom Shaw, Sandwich, Massachusetts.

Claim.—"The improvement upon this kind of shell whereby I am enabled to use melted metal as the incendiary material, and which consists in lining the chamber of the incendiary material with some non-conducting and refractory substance, such as pipe clay, black lead, &c., and perforating the iron to allow the escape of the gas therefrom, thereby providing against premature explosion, and retaining the heat in the melted metal."

48. For an *Improved Mould Candle Machine;* Benjamin D. Sanders, Holliday's Cove, Virginia.

"My improvement has for its objects the manufacture of stearine, and other mould candles, with greater celerity, convenience, retention at the proper stretch, and exactness as regards central position of the wick in the mould, and improves the candle made."

Claim.—"Causing the wick centering slide to stretch and hold the wick in the mould by its operation on the wick when bent over the slide, and said bent portion of the wick having the drawn candle attached or suspended to it in rear of the notched edge of the slide."

49. For an *Improvement in Projectiles for Rifled Cannon;* John M. Sigourney, Watertown, New York.

Claim.—"Recessing the cylindrical part of cylindro-conical shot and shells, in such a manner that the contact of said shot and shells with the bore and grooves of the gun be confined to the projecting ribs and belts, which belts and ribs are finished to fit the bore and grooves with precision."

50. For an *Improved Method of Operating the Supply and Discharge Valves of Hydraulic Engines;* Homer H. Stuart, City of New York.

Claim.—"Arranging the four flap valves on the rock-shaft to operate in the separate compartments of the two valve boxes placed at one end of the cylinder, and operating the same by means of the sliding arch piece, connected with arms at opposite ends of the said rock-shaft and driver by the vibrating arm of the rock-shaft of the main engine."

51. For an *Improvement in Cast Iron Pavements;* Charles J. Shepard, Brooklyn, New York.

Claim.—"Forming polygonal metallic paving blocks, with the inclines at the upper part of the straight sides, and with the projections to take the inclines of the adjoining blocks at unequal distances from the angle of said blocks."

52. For an *Improvement in Machines for Husking Corn;* Hiram Strait, Covington, Kentucky.

Claim.—"The toothed drum with its projecting saw or knife and cam, in combination with one or more ear holders."

53. For an *Improvement in Door Springs;* Leopold Thomas, Allegheny City, Penna.

Claim.—"The use of compound lever, in combination with the connecting arms and spiral springs, or their equivalent."

54. For an *Improvement in Melodeons;* Thomas F. Thornton, Buffalo, New York.

Claim.—"The combination of an extra adjustable lever with each of the push-down pins."

55. For *Improved Portable Fire Arms;* John Tilton and William Floyd, Rock House, Ohio.

Claim.—"The combination of the levers and spring and bridle, for effecting the simultaneous release of the trigger, and removal of the muzzle cover."

56. For an *Improvement in Guide Wheels for Railroad Cars;* John B. Wickersham, City of New York.

Claim.—"The guide wheels at the front and rear ends of the car, when combined with the grooved rail, and attached to the car."

57. For an *Improvement in Harvesters;* David Watson, Newark, New Jersey.

"This invention relates to a certain improvement in harvesters, wherein a peculiar provision is made for discharging the cut grain from the platform in sheaves or gavels."

Claim.—"The gate, in combination with the inclined endless apron and platform."

58. For an *Improvement in Machine for Hulling and Scouring Wheat, &c.;* Joseph Weber, Braysville, Indiana.

"The nature of my invention consists in the construction and arrangement of parts of a machine for hulling wheat and other grains, and for scouring the same in its own dust, performing the operation previously moistening the grain."

Claim.—"1st, The polygonal chamber, when made so that the grain will be turned over and over during its descent through the chamber, and be rubbed without being broken. 2d, The curved and notched arms, in combination with the polygonal chamber. 3d, The combination and arrangement of the polygonal chamber, curved and notched arms, and the smooth triangular arms."

59. For an *Improvement in Operating Valves for Steam Engines;* Norman W. Wheeler, Cincinnati, Ohio.

Claim.—"1st, Actuating the release valves of a steam engine by means of steam pressure derived from the working cylinder, and released therefrom by the passage of the working piston over and beyond appropriate ports, when the receiving valves are actuated by other means. 2d, Actuating the receiving valves of such engine by means of the differential pressure of steam flowing into the steam cylinder, when the resistance to be overcome arises in whole or in part from steam pressure upon one of a pair which are connected together. 3d, Opening the exhaust passages into the cylinder near each end thereof, but within the stroke of the piston. 4th, Connecting puppet valves together in pairs, so that steam pressure upon the one which is closed will hold its fellow open."

60. For *Improved Devices for Aging Liquors;* Anson and A. Spencer Wolcott, East Bloomfield, New York.

"This invention relates to the improvement of alcoholic liquors, by imparting to them what is termed age."

Claim.—"The employment of swinging shelves, or their equivalents, for the purpose of gently agitating the liquors while they are exposed to a moderate heat."

61. For an *Improved Metallic Roof;* Wm. E. Worthen, City of New York.

Claim.—"A roof composed of U shaped metallic beams, which themselves are a portion of the covering, and of arching metallic plates, plain or corrugated, connecting said beams and composing the rest of the covering."

62. For an *Improvement in Back-plates for Fire Places and Grates;* Fountain E. Pitts, Nashville, Tennessee.

"My invention consists in arranging a grating, the bars of which are angular in the throat of a chimney, in such manner as to cause the smoke to pass through it; the peculiar form and arrangement of the bars being such as to arrest much of the heat that would otherwise pass up the chimney, and radiate it into the room."

Claim.—"The back-plate for fire places and grates constructed with the series of angular ridges, furrows, and slots."

63. For an *Improvement in Reflectors for Locomotive and other Lamps;* Isaac Carleton, Brooklyn, New York, Assignor to John Wyberd, Baltimore, Maryland.

Claim.—"The air tight glass cylinder passing through the reflector, in combination with the glass, hermetically sealing the mouth of the reflector."

64. For an *Improvement in Mastic Roofing Materials;* Nathan A. Dyar, Assignor to self and Seth D. Woodbury, Lynn, Massachusetts.

Claim.—"The employment of sulphuric acid (or an acid having a similar effect,) in the treatment of substances or compositions containing hydro-carbon."

65. For an *Improvement in Fluxes for Treating Alloys;* Elie Mowriee and Jules Francois Edward Vallent, Paris, France, Assignors to Henry Migeon, City of N. York; patented in France December 30, 1854.

Claim.—"The employment, in combination of the non-metallic substances (or substances having equivalent properties), in the refining of copper and its alloys, whereby the essential qualities specified are imparted to the copper or its alloy."

66. For an *Improvement in Seeding Machines;* Lewis B. and Henry A. Myers, Assignors to selves and Isaac Myers, Massillon, Ohio.

Claim.—"Measuring and distributing grain seeds or fertilizers by two or more piston heads, and one rod, or their equivalent, operating in and out of an aperture."

67. For an *Improvement in Ships' Steering Apparatus;* John B. Holmes, Assignor to John R. Pratt, City of New York.

Claim.—"1st, The arrangement of a pinion on the end of the tiller working into a stationary curved rack attached to the deck of the vessel, in connexion with a friction roller working against a smooth stationary surface to prevent the rudder from being pressed out of its place. 2d, The arrangement of attaching the pinion to the end of the tiller, in connexion with a beam, in such a manner as to be able to move said pinion further into a stationary rack by the action of said lever, for the purpose of producing a friction sufficient to hold the rudder thereby in any desired position, at the same time to lock the gearing to prevent any back lash on the steering wheel."

68. For an *Improvement in Ships' Capstans;* John B. Holmes, Assignor to John R. Pratt, City of New York.

Claim.—"The vertical recesses and welps extending the whole length of the barrel of the capstan, and allowing of two or more turns of the cable around the capstan."

69. For an *Improved Machine for Swaging Iron;* Junius Foster, Assignor to John Herbold, George Kuhn, and Junius Foster, Brooklyn, New York.

Claim.—"The adjustable block and rollers, and set on and moved by the lever, when combined with the pattern and flanch."

70. For an *Improved Nautical Alarm;* Edward L. Seymour, Assignor to James G. and Charles Wright, and Henry I. Geyer, City of New York.

Claim.—"The combination of frame, rods, hammers, axles, springs, pendulum, levers, and gongs or bells, to be placed upon buoys, floats, or vessels of any kind, for the purpose of causing alarm, and giving warning of rocks, shoals, or other dangers upon the coasts or at sea; and I do not mean to confine myself to any particular materials in the construction of the same, nor to the placing of the ring, levers, and springs, above or below the centre of oscillation, but to vary the position of the same, and of the gongs, and their number, as I may deem desirable."

71. For an *Improved Machine for Reducing and Smoothing Boards to uniform thickness;* Tristram D. Knight, Charleston, Tennessee.

"It is the main object of my invention to secure all the advantages resulting from the efficiency of the rotary cutter, its simplicity of construction, its cheapness, and its durability, and at the same time to finish the lumber with a plane surface."

Claim.—"The combination of the reducing saw, with the finishing grinder."

72. For an *Improvement in Pointing and Threading Screws;* Daniel M. Robertson, Manchester, New Hampshire.

Claim.—"A pointing tool, arranged in connexion with one or a series of threading tools, and traversed slower than the threading tools, and so far in advance of them as to form the point of the screw-blank, and prepare it for the threading tools; and I make this claim whether the pointing tool is traversed by the devices described, or by such other devices as will answer the purpose.' Also, the plate or guide when made to traverse, whether it is operated by the devices described, or such others as will answer the purpose."

MECHANICS, PHYSICS, AND CHEMISTRY.

*Address before the Institute of Mechanical Engineers, Sept. 17th, 1856.**

By Joseph Whitworth, Esq., President.

At a Special General Meeting of the Members held in Glasgow, Joseph Whitworth, Esq., President, in the Chair,—after the reading by the Secretary, of the minutes of the last General Meeting, the President delivered the following opening address:—

Gentlemen,—This being the first time I have taken the Chair since you did me the honor to elect me your President for the present year, I propose to address you shortly on a few topics more or less connected with our profession of mechanical engineering. But first, let me express my gratification, and I am sure that of my fellow-countrymen, in thus meeting our northern friends in this important city of the mechanical arts. Formerly, it was said of the Scotch mechanic, that once south, he never crossed the Tweed a second time; but the science with which we are so immediately connected has so shortened time and distance, that those circumstances are changed ; for now he no longer has occasion to bid good-bye to his native land, but, thanks to railways, the penny post, and the electric telegraph, can keep up his family connexions, and return occasionally to see those who are dear to him, and to enjoy the scenes of his early recollection.

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* From Newton's Lond. Journ. of Arts and Sciences, Feb., 1857.

The city of Glasgow is peculiarly interested in the mechanical arts, for the minerals for making iron are found in great abundance in this locality; indeed, it is to this neighborhood, more than to any other, that the world is indebted for the cheapest and most abundant supply of iron. Here, too, that metal is converted into a great variety of machinery. There are large manufactories of the steam engine—fixed, marine, and locomotive. Cotton manufacturing and various other kinds of machinery are also made here in considerable quantities. With such links of connexion amongst us, I trust that this, our first meeting in this city, may be the forerunner of many others, and that we shall add many valuable members to our institution.

With regard to the manufacture of malleable iron and steel, it was with great gratification that I read the account of Mr. Bessemer's invention, so beautiful and simple as apparently to leave nothing further to be desired in that part of the process. I need not tell you of what vast importance it must be to those who are more immediately connected with those branches of mechanics requiring nicety of workmanship, to have iron and steel of a better quality. I may mention, that in making rifle barrels for the experiments which I have undertaken for the government, one of the greatest difficulties I encounter, in attaining the degree of accuracy that I require, arises from the defects in the iron. What we want is iron of great strength, free from seams, flaws, and hard places. Inferior iron (with the use of other defective and improper materials) is, perhaps, the main cause of one of the greatest errors committed in the construction of whatever in mechanism has to be kept in motion. I mean the increase of size of the parts of a machine or carriage, in order to get strength, thereby adding weight until they are considered to be strong enough. In our vehicles of draft and carriages this is strikingly the case. Now this ought not to be. Lightness is the thing to aim at, and safety should be sought in the elasticity, form, and good quality of the material. Should a carriage be found to twist and get out of form, that would be a proof of its being too light. But to prevent a carriage breaking down by increasing the size of its parts, and thereby adding weight, is mechanically wrong. Indeed, it is quite distressing to see the enormous weight of our carriages, particularly those drawn by animal power. It should be an axiom in mechanics, that whatever has motion, should be as light as circumstances will admit; and this applies equally, whatever the source of power may be, whether the motion is produced by human, horse, or steam power.

I would next call your special attention to the vast importance of attending to the two great elements in constructive machines,—namely, a true plane and the power of measurement. The latter cannot be attained without the former, which is therefore of primary importance; and its accomplishment is so easy and so simple as to leave without excuse any establishment neglecting to secure it. It is necessary to make three planes in order to obtain a perfect one, and cast iron is the best material generally to use. Whatever the size of the plane required, the tripod form is absolutely essential for its support; and the strengthening ribs must be placed with reference to the supports. I cannot impress too strongly on the members of the Institution, and upon all in any way connected with mechanism, the vast importance of possessing a true plane, as a standard for reference. All excellence in workmanship depends upon it. I may mention that it was at the meeting of the British Association, held in Glasgow in 1840, that I read a paper on the mode of producing a true plane, to which I would refer those desiring information on the subject.

Next in importance to a true plane is the power of measurement. I have brought with me, for your inspection at the close of the meeting, a small machine, by which a difference of length of the one-millionth part of an inch is at once detected. The principle is that of employing the sense of touch, instead of sight. If any object be placed between two parallel true planes, adjusted so that the hand can just feel them in contact, you will find, on moving the planes only the fifty-thousandth of an inch nearer together, that the object is distinctly tighter, requiring greater force to move it between them. In the machine before you, the object to be measured is the standard inch, in the form of a small square bar, both ends being true planes; and in this case, in order to measure with the utmost accuracy, a thin flat piece or bar is introduced, having its two sides made also perfect planes. This is placed between the inch bar to be measured and one of the end surfaces of the machine. This thin bar, which I name the gravity piece, is brought into contact with the two planes, so as just to allow it, on being raised, to fall by its gravity; and you will find that, by bringing the planes into closer contact by even the one-millionth of an inch, the gravity piece will be suspended,—friction overcoming its gravity. This machine, and a larger one, are used for making standards of length. When the standard yard, which is a square bar of steel, is placed in the larger machine, and the gravity piece adjusted so as just to fall by its weight, the heat imparted from the slightest touch of the finger instantly prevents its fall; thus showing the lengthening of the bar by so small an amount of heat as I have indicated. We have therefore in this mode of measurement all the accuracy we can desire; and we find in practice in the workshop, that it is easier to work to the ten-thousandth of an inch from standards of end measure, than to the one-hundredth of an inch from the lines on a two-foot rule. In all cases of fitting, end measures of length should be used, instead of lines.

This question of correct measurement is in immediate connexion with another, which will repay all the attention that can be given to it, and I think there is no subject that can be more profitably discussed amongst us;—I mean that of proper gradation of size in all the various branches of the mechanical arts. I think no estimate can be formed of our national loss from the over-multiplication of sizes. Take, for instance, the various sizes of steam engine—stationary, marine, and locomotive. In the case of marine engines, the number of sizes up to 100-horse power will probably not be short of thirty, where ten perhaps would be ample. If so, look at the sums expended in patterns, designs, and in the number of tools for their manufacture. Nor is this all; for if there were only ten sizes instead of thirty, there would be three times the number made of each pattern; and, as you know, the very soul of manufacture is repetition. By attention to this, the ship-owner would be benefited by getting a better engine at a less price. In the case of locomotives and carriages, I would urge the subject on the attention of our members, the engineers of the great lines of railway—the London and North Western, the Midland, the Great Northern—for instance. I hope they will permit me to suggest that they should consider and determine not only the fewest possible number of sizes of engines and carriages that will suffice, but also how every single piece may have strictly defined dimensions. This question is also well worthy the attention of our architects and builders. Suppose, for instance, that the principal windows and doors of our houses were made of only three or four different sizes. Then we should have a manufactory start up for making doors, without reference to any particular house or builder. They would be kept in stock, and made with the best machinery and contrivances for that particular branch; consequently, we should have better doors and windows at the least possible cost. Our friends across the Atlantic manage matters in connexion with their buildings much better than at present we do.

I hope the members of this Institution will join me in doing what we can with reference to those two important subjects—correct measurement, and its corollary, proper gradations of size. The want of more correct measurement seems to pervade everything. Take, for instance, the case of the common brick, which ought to be three inches thick. Who is there that has made an addition to a building who has not felt inconvenience from the irregularity of size?—the new brick being perhaps too thick, and so not allowing sufficient mortar to be used; or too thin, and requiring too much mortar.

Perhaps one of the most effectual means that could be adopted, in the first instance, to remedy this unsatisfactory state of things, would be for the government to supply corporate bodies with proper standards of length—such as the inch, the foot, and the yard. The corporate bodies themselves might then have their own standards of size, founded on these, and made to suit the particular wants of the different trades in the locality. The only standard of length at present supplied by the Government, and kept by the corporate bodies, is the standard yard, but there is so little attention paid to accuracy, that to the engineer and machinist it is not of the slightest use, and is only employed to adjust yard sticks for measuring woven goods.

There is also another subject which bears upon this question, and which has lately been brought before the Legislature—that of decimalizing weights and measures. There can be no doubt of the beneficial results that would follow the passing of such a measure. There may be a difference of opinion as to what the unit or integer of lineal measure should be; but I am of opinion that it should be the inch, for, from the accuracy with which we can now measure that length, there would be no difficulty in determining and fixing the length of its multiples. The most important divisions of length in mechanism are those of parts of an inch, and if the length of the inch were altered it would cause much confusion. Small accurate standards of length, of the decimal parts of an inch, would be of much service to some trades. There is now no standard of appeal; and the different wire and other gauges differ so considerably, that the manufacturer, in the case of small wire and sheets of metal, has to send a sample of what he wants, there being no means of correctly expressing its size.

Although I have said so much to you with reference to the desirableness of further improvement and greater perfection in the mechanical arts, I congratulate you on the success which in our time they have attained, and the high consideration in which they are held. Inventors are not now persecuted, as formerly, by those who fancied that their inventions and discoveries were prejudicial to the general interest, and calculated to deprive labor of its fair reward. Some of us are old enough to remember the hostility manifested to the working of the power loom, the self-acting mule, the machinery for shearing woolen cloth, the threshing machine, and many others. Now, the introduction of the reaping and mowing machines and other improved agricultural machinery is not opposed. Indeed, it must be obvious to reflecting minds that the increased luxuries and comforts which all more or less enjoy, are derived from the numerous recent mechanical appliances and the production of our manufactories. That of our cotton has increased during the last few years in a wonderful degree. In 1824, a gentleman with whom I am acquainted sold on one occasion one hundred thousand pieces of 74-reed printing cloth at 30*s*. 6*d*. per piece of 29 yards long; the same description of cloth he sold last week at 3*s*. 9*d*. One of the most striking instances I know of the vast superiority of machinery over simple instruments used by the hand is in the manufacture of lace, where one man with a machine does the work of 8000 lace-makers on the cushion. In spinning fine numbers of yarn, a workman on a self-acting mule will do the work of 3000 hand-spinners with the distaff and spindle; and there are other striking facts of a similar kind mentioned in my report on the New York Industrial Exhibition.

Comparatively few persons, perhaps, are aware of the increase of production during our lifetime. Thirty years ago, the cost of labor for trueing a surface of cast iron, by chipping and filing with the hand, was 12*s*. per square foot: the same work is now done by the planing machine at a cost for labor of less than 1*d*. per square foot, and this, as you know, is one of the most important operations in mechanics. It is therefore well adapted to illustrate what our progress has been. At the same time that this increased production is taking place, the fixed capital of the country is, as a necessary consequence, augmented; for, in the case I have mentioned of chipping and filing by the hand, when the cost of labor was 12*s*. per foot, the capital required for tools for one workman was only a few shillings; but now the labor being lowered to 1*d*. per foot, a capital in planing machines for the workmen is required, which often amounts to £500, and in some cases more. This large outlay of capital invested in machinery to increase production, makes it impossible to curtail the hours of working machinery as much as could be desired. In some cases two sets of workpeople have been employed in relays, each working eight hours a day; and this system, perhaps, may in time be extended, although it is attended with certain inconveniences. If, however, the relay system could be so improved and organized as to allow more time for the better education of young operatives, none would more cordially rejoice than myself. I believe that mechanics, though a mere material power in itself, may, if rightly used, become a moral lever, by which, like Archimedes of old, we may seek to raise the world.

There is at the present time a very gratifying circumstance in connexion with the extension of machinery; namely, the large remuneration which the operatives receive compared with those who perform hand labor without the help of machinery. I would here mention, with reference to the amount of wages paid to the operative, that it does not depend solely on the master manufacturers of this country, but is governed in some measure by what is paid by the manufacturers of other countries who are in competition with our own. When in America in 1853, I found that the American operatives received somewhat more wages than are paid in this country; but they worked much longer hours, although the climate, during some parts of the year, is so unfavorable. These longer hours enable the American manufacturer to turn over his capital more frequently.

This question of increased production, with which we, as mechanical engineers, are so identified, is so entirely dependent on the power of the people to consume, that I hope I shall be excused in adverting to it. Our yearly exports now amount to about a hundred millions sterling, having doubled in a short time, while our home productions have been greatly increased from the same cause, namely, the increased ability of our people to consume. As a general principle, it would seem to be far better to levy a small impost on the entire wealth of an individual than to fasten a tax on particular objects, which, if produced, would constitute wealth, but which are not made because of the threatened impost. The remaining duty on carriages seems to me to be one of this description. Were there no tax, almost every one who keeps one carriage would keep more, while large numbers would have one who now have none. By their use, locomotion would be increased threefold, and hence much valuable time would be saved. Besides, what a number of the best description of artisans would be called into existence for their manufacture—a class, too, who are well able to turn their hand, in cases of necessity, to other employment. If, therefore, it is desirable for a nation to possess wealth in carriages, it is a mistake in legislation to prevent it.

Formerly, when the wealth of a nation was produced as it were by hand labor, a different state of things existed to that of the present day. As I have shown, our means of production are now increased in some cases more than a hundred, and in others more than a thousand fold; and this will go on just in proportion as the masses of our people are able to consume larger quantities of everything that they require. When the farm laborer pays less for his sugar and tea, more meat will be consumed (which again goes to improve the land); also more wool for our manufacturers.

In this wonderful power of producing wealth which now exists, none can be more interested and benefited than the proprietors of the land. A striking proof of this is given by its increased value in the manufacturing counties, and for miles adjoining our manufacturing towns. The competition too of our manufacturers and merchants to become possessors of land, is shown by the small rate of interest with which they are satisfied for the outlay of their capital on the soil. The proprietors of land may rest assured that, in the future development of mechanical improvements, none will be more benefited than themselves. I do not hesitate to say that all harvest operations on land properly laid down, will very shortly be performed in one-fourth the time required with the hand labor now expended, by the farther application of machines worked by horse power. This is my conviction, based upon the experience I have had in the successful working of the machine I constructed for sweeping the streets, and at the same time filling the cart, by horse power. By the combined aid of mechanical improvements and the science of chemistry, together with the greater skill of our modern agriculturists, the culture of the land throughout Great Britain must more and more approximate to that of a garden.

We have seen the effect of the repeal of the duties on glass and bricks, in the improved appearance and reduced cost of residences, and a still further benefit may be expected to result from the removal of the remaining duty on timber. While therefore we congratulate ourselves on the great results which the mechanical arts have achieved, we have every reason to be thankful that our legislators have removed so many impediments to our progress. The glorious fruits of the legislative labors of that great and good man, Sir R. Peel, may give us hope that the time is not far distant when all remaining obstacles of this kind will be swept away. When that period has arrived, and when the industry of this country has been systematized upon sound principles of economical science, and in each department carried nearer to those standards which, in the case of mechanics, I have endeavored to indicate, we shall have less reason than at present to doubt the stability of our manufacturing preeminence.

Rendering Stuffs Water-proof.

The following is the method patented by M. Menotti for rendering stuffs water-proof, and yet allowing them to remain permeable to air. We translate the French measures assuming the litre as a quart, and the kilogramme as two and a quarter pounds avoirdupois.

Take two vessels of a capacity of five gallons each; place in one 22 lbs. of commercial sulphate of alumina chopped up fine; in the other, 9 lbs. oleic acid and $1\frac{1}{2}$ gallons, alcohol $\frac{3}{6}$. Stir this mixture well, and pour it into the first vessel, taking care to stir well with a wooden ladle during the mixture, and for ten minutes afterwards. Let the mixture stand for 24 hours, then decant the oleic acid and alcohol which are floating on top. Throw the precipitate upon a felt filter, and press until all the liquid is run out. Take the precipitate from the filter and dry at 86°; when dried, powder it by rolling it upon a table with a wooden roller. This compound the author calls *hydrofugine.* To use this, dissolve it in 150 times its weight of warm water for woolen stuffs, while for linen, cotton, or silk, 100 times the weight will be enough. Filter the solution through linen, and plunge the stuffs to be water-proofed into it ; soak them well, then take them out and wring them; soak them a second time, then take them out and dry them either in the air or before a fire. The stuffs will be found, when well dried, impermeable to water, but not to air. The quantity of hydrofugine necessary cannot be accurately determined, but generally 1 oz. is enough for two yards of cloth or four of muslin.

M. Thieux, of Marseilles, proposes a simpler process. In two vessels, each of a content of 12 gallons of river water are dissolved, in the one $3\frac{1}{3}$ lbs. of alum, in the other the same weight of sugar of lead. When the solutions are complete, pour the liquids together, by which will be formed an insoluble sulphate of lead, and soluble acetates of alumina and potassa, mixed with a slight excess of alum. As soon as the liquid has become clear, it is drawn off and the stuffs plunged into it; they must be strongly compressed while under the liquid to expel the air from their pores, and then suffered to soak for at least four hours, so as to insure the perfect penetration of the liquid everywhere. When withdrawn they are lightly shaken, then dried, brushed, and pressed with a hot iron. It appears that various specimens of cloth experimented on by the Committee, absorbed from 11 to 17 per cent. of their weight of saline matters, and retained their original appearance, and their pliability at all temperatures. But after immersion in fresh water for 24 hours, they lost all their additional weight. As to the efficacy in this process, there appears to be a very serious difference of opinion, the conclusions of the committee appointed to examine it, as reported by M. Jacquelan, are that it is not new, nor as good as was announced ; but it had been tried and approved for five years by the Lyons and Mediterranean Railroad Company ; that the committee could not tell whether it was durable or not: its cost was about 20 cents for water-proofing a coat or pair of pantaloons. On the other hand, M. Balard, known to all, as one of the most distinguished and careful chemists of France, reports that the thinnest woolen cloths impregnated with it, are totally impermeable to water after weeks of contact with it, that the water evaporates from them and does not pass through; that cloths which had been soaked for 48 hours in fresh water, were as impermeable afterwards as before ; that clothes rendered waterproof in this way, and exposed on wicker-frames to the rains of October, never allowed a drop of water to pass ; that a cloak of cloth thus prepared, stretched over a willow frame, and exposed to the stream from a fire engine worked by six strong men, from a distance of 15 yards, allowed no water to pass, except where the stuff was in contact with the frame and was compressed upon it by the violence of the jet, but the transpiration from the skin appears to destroy the impermeability, so that it is probably applicable only to exterior clothing; finally, that there is every probability that it is lasting, as appears from the certificates. M. Balard himself testifies that an overcoat worn by him for five months, which had been beaten and rubbed and subjected to all the ordinary usage of overcoats, remained perfectly impermeable. Clothes prepared in this way are said to be softer to the touch, warmer, absorbing less moisture, drying more quickly, and therefore more durable.

It would appear, therefore, that this process, which is cheap and easily applicable, even after articles are made up, is well worth experimenting upon. *Bull. Soc. Encour., Sept. and Dec.*, 1855.

Electric Gilding, Silvering, and Platinating.

M. Landois, of Paris, announced to the Society for the Encouragement of National Industry, at their session of 25th December, 1855, that he had obtained a gold, silver and platina bath, having no deleterious exhalation and capable of depositing solid coating upon the metals. M. L. dissolves a given weight of cyanide of gold, silver or platina, in a saturated solution of common salt; the solution is filtered and may be then used. The galvanic deposit takes place cold very rapidly, and the results are equal to those obtained by MM. Ruotz and Elkington.

On various Phenomena of Refraction through Semi-lenses or Prisms, producing anomalies in the Illusion of Stereoscopic Images. By A. Claudet, Esq., F.R.S.*

The author having observed that photographic pictures representing flat surfaces, when examined in the refracting stereoscope, have the appearance of concavity, has endeavored to discover the cause of that phenomenon, and to explain it.

In order to ascertain if this peculiar effect was attributable to some imperfection in the lenses of the camera obscura which had produced the photographic pictures, or to a property of the stereoscope itself, he began to test the stereoscope without photographic images. For this experiment he placed under each tube of the stereoscope a diagram composed of vertical and horizontal lines crossing each other.

The two diagrams perfectly identical, when seen in the stereoscope coalesced and formed only one figure; but although each diagram, when seen separately by its corresponding eye, appeared perfectly flat, still the coalescing image of the two presented a surface conspicuously concave; consequently there was no doubt that the same illusion observed in photographic pictures was due only to the effect of the stereoscope. This experiment was decisive, and it remained to discover how the illusion was produced. The investigations showed that the phenomenon, which is a defect detrimental to the beauty and correctness of the stereoscopic representations, and unavoidable in the refracting stereoscope, is a plain illustration of the cause of relief and distance, and yield the clearest explanation of the stereoscopic illusion,—proving that it is founded on the true principles of natural binocular vision.

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* From the Lond. Repertory of Patent Inventions, Feb., 1857.

When we look through a prism placed near the eye at a straight line, the refracting edge of the prism being parallel with the straight line, that line is refracted laterally and appears bent, with its concave side turned to the thin edge of the prism. The two tubes of the stereoscope being supplied with semi-lenses acting as prisms, each lens bends all vertical straight lines, and the concave sides of these lines are turned towards the thin edges of the lenses, and consequently towards each other. When we examine in the stereoscope two curved lines having their concave sides turned towards each other, the result of the coalescing of these two lines is a concave line, the extremities appearing nearer and the centre further. If the convex sides are turned towards each other, the result of the coalescence is a convex line, the extremities appearing further and the centre nearer. By the same reason, if straight lines are bent by the prismatic refraction of the two semi-lenses, as the bending is effected so that the concave sides are turned towards each other, the result is by coalescence a concave line. The two photographic images will have all their vertical lines bent in the same manner, and the stereoscope will give the illusion of a picture represented on a concave surface.

When we look at natural objects, the optical axes have to converge more for the nearest than for the furthest, in order to obtain a single vision by bringing the same object on the centre of each retina; therefore by habit we judge of the distances by the angle formed by the optical axes required to obtain a single vision. Again, while we look at one object, while other objects in the same line are situated before and behind that object, we have the sensation of their double images on the two retina. The double images of nearer objects are situated in the following order: one on the right of the centre of the right retina, and the other on the left of the centre of the left retina; and the double images of further objects, one on the left of the right retina, and the other on the right of the left retina.

In looking at the two pictures in the stereoscopes, we have to converge the optical axes on one point which is beyond the plane of the pictures, so that two of their correspondent or similar points appear respectively on the two lines forming the angle of convergence of the optical axes, and each of these points is represented on the centre of one retina. As the two corresponding points of the two pictures are laterally nearer each other for the first plane and more distant for the receding plane, it follows that the optical axes have to converge beyond the plane of the pictures on a nearer point for the first, and on a further point for the last. Therefore, the angle of convergence by which similar points of the two pictures appear on each axis, and consequently fall on the centre of each retina, conveys the sensation of their respective distances; more convergence indicates less distance, and less convergence more distance. All the other corresponding points of the two pictures which are not on the optical axis, or on similar points of the two retina, form double images; and when we look at one point, all the points of nearer and further planes appear double in the same order on the two retina, as when we look in like manner at natural objects: and the situation of double images seen through the stereoscope indicates the distances of the objects they represent, according as one is on the right of the right retina, and the other on the left of the left retina, or one on the left of the right retina, and the other on the right of the left retina.

This being explained, it is easy to understand what will be the stereoscopic result of vertical lines represented as curved, and having their concavities turned toward each other. The two correspondent points of the top and bottom of the two concave lines being nearer each other, will require more convergence than the two correspondent points of the centres of the concave lines, and will appear nearer, whilst the two points of the centre requiring less convergence will appear further; the intermediate points from the centres to the extremities of the two bent lines will appear gradually less distant, therefore the coalescence of the two lines bent laterally will produce the illusion of a single line conspicuously concave, in a vertical plane at right angles with the plane of the two separate lines.

Having demonstrated that the semi-lenses of the stereoscope, like prisms, bend laterally all the vertical lines of which the photograph pictures are composed, and that these lines in the two pictures present their concavity to each other, it is evident that the coalescence of the two images must give the illusion of a concave image.

The phenomenon of the lateral curvature given to vertical lines by the refraction of a prism, which vertical lines, when examined with two prisms, one for each eye, appear by coalescence as one line concave in a vertical plane at right angles with the plane of the two separate bent lines, can be curiously illustrated by the following experiment:—

If, holding in each hand one prism, the two prisms having their thin edges towards each other, we look at the window from the opposite end of the room, we see first two windows with their vertical lines bent in contrary directions; but by inclining gradually the optical axis, we can converge them until the two images coalesce, and we see only one window; as soon as they coincide, the lateral curvature of the vertical lines ceases, and they are bent projectively from back to front: we have then the illusion of a window concave towards the room, such as it would appear reflected by a concave mirror.

There is another phenomenon which can be noticed when looking at photographic pictures in the stereoscope; sometimes the pictures appear to project out, and sometimes to recede from the mountings. The first effect lessens the illusion, and the second renders it more effectual; therefore it is desirable to inquire how we can avoid the one and ensure the other.

We know that the distance of objects is in an inverse ratio with the angle of convergence required to see them single; also that with symmetrical figures or photographic pictures, when the horizontal or lateral distances of the several corresponding points is different, the points less separated will appear nearer, and the more separated will appear further.

Suppose the two correspondent vertical lines of the openings or frames of the pictures be more distant than the two correspondent points of the furthest plane of the picture themselves, then the openings or frames will appear behind the pictures; and suppose the correspondent vertical lines of the openings be less distant than the two correspondent points of the nearest plane of the pictures themselves, then the openings or frames will appear before the picture.

Therefore, when we wish to have the picture appearing behind the openings or their mountings, we have only to take care that the correspondent vertical lines of the mountings should be laterally less distant than the two correspondent points of the first plane of the picture. This can be easily done by taking the measure of the two correspondent points of the first plane by means of a pair of compasses, and tracing the two pairs of correspondent vertical lines bounding the openings, after having slightly reduced the angle of the compasses.

A very simple experiment may show the cause of the illusion of concavity of flat surfaces when examined through semi-lenses, and further prove that semi-lenses may give alternately the illusion of concavity and convexity according to the position of their thin edges; of concavity when their edges are towards each other, and of convexity when they are placed contrarywise. For this experiment we have only to employ a pair of those spectacles mounted with a spring whereby they are held on the nose.

When we read, holding such spectacles with both hands, we may by the elasticity of the spring adjust the two lenses so that the pupils of the eyes can coincide, first, with the two nearest edges; secondly, with the two centres; and, thirdly, with the two furthest edges of the lenses.

In the first case, the page of the book will appear concave, because the pupils will look through the thin edges of the lenses which bend the vertical lines with their concave sides turned towards each other; in the second, the page will appear flat, because the pupils will look through the centres of the lenses which show the vertical lines perfectly straight; and in the third case, the page of the book will appear convex, because the pupils will look through the thin edges of the lenses which bend the vertical lines with their convex sides turned towards each other.

These considerations have led the author to construct a stereoscope which presents flat surfaces perfectly flat. This new stereoscope has two entire lenses instead of two semi-lenses, and the eyes look through the centre of such lenses. The images not being laterally refracted, as in the semi-lenticular stereoscope, their coalescence requires a certain effort of divergence, or to squinting outwards, which a little practice will enable us to perform easily. Persons capable of using this kind of stereoscope will see a picture whose surface is perfectly flat with all the illusion of relief and distance.

All lenses being more or less subject to the defect of bending straight lines when refracted by all the various points of their surface but the centre, and in a greater degree as those points are nearer the edges, it results that when images are produced in the camera obscura by the various points of the whole aperture, they will be bent in various contrary directions, and a certain confusion must arise injurious to the delicacy and correctness of the whole compound image. This may be proved by the following experiments:—If we take the image of a window by a small aperture placed on the right edge of a lens, say of three inches aperture, and another image of the same window, by placing the aperture on the left, taking care to shift the camera so that the two apertures will be exactly on the same line, we shall have two images of the same window apparently identical; but in placing these two images side by side in the central lens-stereoscope above described, first the image of the left side aperture on the right, and that of the right side aperture on the left, secondly the images *vice versa*, we shall see in the first case a concave window, and in the second a convex window. But in examining the two images in the semi-lenticular stereoscope, we shall see in one case a concave window, and in the other a perfectly flat window, because in the first case the stereoscope will have increased the bending of the vertical lines of the two images, and in the second the stereoscope will have corrected the bending.

This fact naturally suggests the possibility of correcting the defect of the refracting stereoscope; for if the images of the camera were taken by semi-lenses, the bend resulting from this mode of operating might be corrected by the bend of the stereoscope, care being taken to turn the thin edge of the semi-lenses of the two cameras in the direction which will produce a bending contrary to that of the semi-lenses of the stereoscope.

Having shown how the lateral proportional distances of any two correspondent points of the two stereoscopic pictures are the indices of their perspective distances, if we were, while looking in the stereoscope, to produce a change in those proportional lateral distances by sliding horizontally in a contrary direction, two pairs of superposed glass photographic pictures, the objects would appear to move, not in the horizontal lateral direction of that change which they naturally have, but in a straight line forward and backward, as if the object was approaching or receding.

But the most curious effect of that motion would be, that the objects would appear increasing in size while they were receding, and diminishing while approaching, which we know is contrary to the rule of perspective. This is another illusion entirely physiological, and the cause of which may be thus explained; while the object appears moving forward and backward it remains always the same size, but as we expect when it moves forward that it should increase in size, and when it moves backward that it should decrease, and as it does not, we feel that it is diminishing when approaching and increasing when receding. —*Philosophical Magazine.*

Lightning-Rod Points.

As the perfection of the lightning-rod ought to interest our readers in this country in an especial degree, we copy from the *Bulletin of the Society for the Encouragement of National Industry, of France*, the accompanying drawings of lightning-rod points. They are too simple to need much description. They are sections, 1st, of the point recommended by the Academy of Science, on the report of Messrs. Pouillet, Becquerel, Babinet, Duhamel, Despretz, Cagniard de Latour, Regnault, and de Senarmont; it consists of a solid cone of platina screwed upon the iron rod; fig. 2d, of the improvement submitted by M. Deleuil, and approved by the Committee; it consists of a hollow platina shell of conical form soldered on the conical extremity of the rod.

The Committee add that they see no objections to making the point of palladium, gold or silver of 950 fineness, either solid or in sufficiently thick shell, provided care be taken that the soldering shall be effective on the whole surface. They also recommend on account of its cheapness, fig. 3d, a cylinder of copper 0·8 inches in diameter, brazed upon the end of the iron rod, and terminating in a cone $1\frac{1}{4}$ to $1\frac{1}{2}$ inches in height; and they say that the danger of oxidation of such a cone, is more than compensated by the advantages, which are, first, the high conducting power of copper; and, secondly, its cheapness. In regard to this, we would remark, first, that the conducting power of the point will be limited by that of the rod, and that any metal which will conduct as well as iron will answer in this respect equally well for the point. Secondly, that if we admit the liability of a good rod to be struck, as the Committee do, then the great fusibility of copper renders such a point dangerous. Thirdly, the platina work in Europe seems, from recent developments, to be still done by welding platina sponge, and we are not aware of any experiments to determine the electro-conducting power of platina which has been perfectly fused. We all know that the crucibles made from platina sponge are in laminæ, between which there is no true metallic contact. Fourthly, it seems worth while to inquire into the feasibility of using iridium, which is so largely contained in the gold from California; which is less fusible than platina, yet may be melted in masses large enough to make lightning-rod points.

Fig. 1.

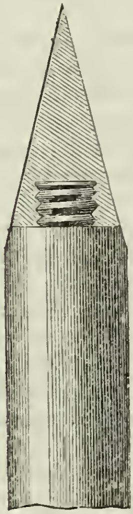


Fig. 2.

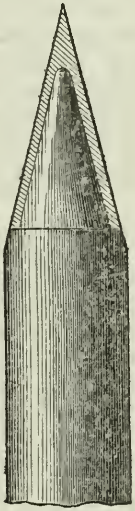
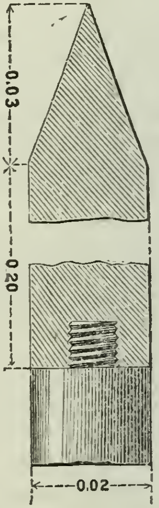


Fig. 3.



Experiments on Wrought Iron Beams. By THOMAS DAVIES, F.A.I.S.*

Read at a Meeting of the Architectural Institute, held in Edinburgh on Feb. 18, 1856.

The material first used in the construction of beams was doubtless timber, and although it has many properties peculiarly fitting it for this purpose, yet, on account of its flexibility, and the difficulty of getting it of sufficient size and strength for long spans, its tendency to decay, and its destructibility by fire, it is in many cases unsuited for the purpose required.

When the manufacture of cast metal became more general, and the means were obtained of making large castings, the applicability of this material to the formation of beams could not fail to suggest itself. This material has decided advantages—in its rigidity, in its capability of being made of almost any required shape and strength, in its non-liability to decay, and in its incombustibility; and consequently, it has come to be very extensively used for the purpose referred to.

There has, however, been a general want of confidence in beams of this material, arising from different causes. One objection is, that when a beam gives way, it does so without any previous warning. Another objection is, that although we have innumerable experiments on the strength of cast metal, by which we are enabled to calculate the amount which any particular beam of this material ought to carry, it does not follow that it will bear that amount. In a large casting there may be some inequality in the metal used ; again, if there is much difference in the thickness of the parts, the cooling of one part before another produces, to some extent, a tendency to fracture, especially if subjected to any sharp concussion ; or the casting may be clean and apparently sound, and yet there may be a flaw, of which nothing can be known until it is revealed by a fracture. No doubt, to guard against these defects, we have the system of testing ; but this is not always to be depended upon, as it has been considered, that in some cases beams have been tested so nearly to the limits of their strength, that, though passing the ordeal, they have been permanently injured thereby. This suggests another objection, that though a beam be in every way sound, yet, if it is occasionally subjected to great strains, it will ultimately be so much weakened, as to break with a load much less than the original breaking weight.

The result of the want of confidence abovementioned has been, tha cast metal beams are generally made much stronger than, judging from experiment, they require to be, necessitating heavy castings and increase of cost, with the additional drawback of great weight and difficulty of handling.

Malleable iron beams unite, to some extent, the advantages of both timber and cast metal. They possess the advantage of timber, inasmuch as they are.comparatively light, and therefore easily handled, and when overloaded, they show this by yielding considerably before breaking. They possess the advantage of cast metal in their incombustibility, in their being capable of being conveniently made of any required strength, and even to some considerable extent, in their rigidity ; for although malleable iron is comparatively flexible, yet this quality is in a great measure counteracted by the mode of constructing the beams.

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* From the Lond. Civ. Eng. and Arch's. Jour., January, 1857.

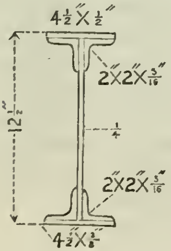
Messrs. Stephenson and Fairbairn, in their investigations and experiments relative to tubular bridges, were the first to call general attention to the use of malleable iron in the construction of beams. After many experiments on various sections of tubes, they arrived at the rectangular tube, or box beam, as the best; and it was a simple step, by dividing it in two by a vertical line, to come to the double flanch or plate beam, which is the most convenient shape for general use.

Mr. Fairbairn, in his valuable book on cast and wrought iron, shows the superiority, in many respects, of malleable over cast iron for beams. He shows, moreover, that, contrary to what takes place in cast metal, the upper flanch requires to be larger than the under one, in the proportion of 2 : 1, and gives formulæ for calculating the strength of beams. There is, however, this drawback, that while his book contains the details of many experiments on various sections of cast metal and malleable iron box beams, there is almost a complete want of experiments on malleable iron plate beams. There is given, in fact, the result of only one experiment on one kind of plate beam, and this experiment was not altogether satisfactory.

This circumstance, there is little doubt, has tended to deter many from adopting this kind of beam. Having made several experiments on the kind of beam referred to, I considered, under the circumstances, that the results of some of these might be acceptable in this Institute, and might tend to the more general use of a beam which has decided advantages for many purposes.

Having had my attention drawn to the applicability of malleable iron for beams, and having long shared in the general want of confidence in cast metal already alluded to, I determined to take the first opportunity of making a trial of them. An opportunity having afforded itself of using them, I consulted Mr. Tod, engineer, Leith Walk, and had the benefit of his experience; and I was so satisfied with the result of the trial, that since then I have not used cast metal for beams of any importance.

The beams in my first experiments, I am sorry to say, were tested by a Bramah Press which I afterwards discovered to be very inaccurate. The results of the experiments, however, which are to be laid before this meeting, are only those which have been obtained by the application of *dead weight*, so that there may be nothing to create want of confidence in the statements now laid before you. These experiments were made at various times in Mr. Tod's yard. None of the beams were tested till they broke, as all were intended for use; but, as most of them were tested to a deflection greater than that to which it would be advisable to have them permanently loaded, they give data for guidance in fixing the dimensions of other beams.



Experiment I.

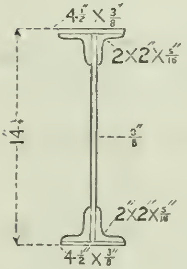
Length of Beam, . .	12 ft. 0 in.
" Bearing, .	11 " 8 "
Weight of Beam, .	4 cwt. 1 qr.

The Load rested on 20 inches in the middle of the Beam.

Divisions of Load.			Load.			Deflection Loading.		Deflection Unloading.	
Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.	Ins.	16ths.	Ins.	16ths.
0	0	0	0	0	0	0	0	0	0
33	0	21	33	0	21	0	2	0	3
42	2	14	75	3	7	0	3	0	4
65	2	14	141	1	21	0	4	0	5 nearly.
38	3	0	180	0	21	0	5		
27	0	7	207	1	0	0	6	0	6 full.
28	3	20	236	0	20	0	7	0	7

Load, . . $11\frac{3}{4}$ tons.
Deflection, . . $\frac{7}{16}$ths inch.
There being no apparent permanent deflection.

Experiment II.



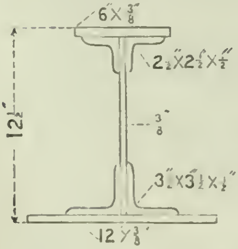
Length of Beam, . 17 ft. 2 ins.
" Bearing, 16 ft. 6 "
Weight of Beam, . 6 cwt. 2 qrs.

The Load rested on 21 inches in the middle of the Beam.

Divisions of Load.			Load.			Deflection Loading.		Deflection. Unloading.	
Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.	Ins.	8ths.	Ins.	8ths.
0	0	0	0	0	0	0	0	0	1
37	2	0	37	2	0	0	1	0	2
33	0	24	70	2	24	0	2	0	3 nearly.
54	2	16	125	1	12	0	3	0	3 full.
52	0	0	177	1	12	0	4	0	4 full.
52	0	0	229	1	12	0	5	0	5

Load, . . $11\frac{1}{2}$ tons.
Deflection, . $\frac{5}{8}$ths inch.
Permanent deflection, . $\frac{1}{8}$th inch.

Experiment III.



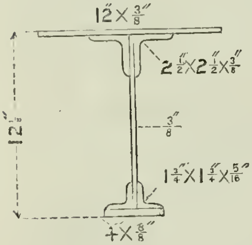
Length of Beam, . 30 ft. 0 ins.
" Bearing, 28 ft. 6 ins.
Weight of Beam, . 20cwt.2qrs

The Load rested on 27 inches in the middle of the Beam.

Divisions of Load.			Load.			Deflection Loading.		Deflection Unloading.	
Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.	Ins.	8ths.	Ins.	8ths.
0	0	0	0	0	0	0	0	0	3
34	1	4	34	1	4	0	2	0	5
12	3	12	47	0	16	0	3	0	6
9	2	16	56	3	4	0	4	0	7 nearly.
13	3	20	70	2	24	0	5	1	0 nearly.
12	3	12	83	2	8	0	6	1	0 full.
16	0	8	99	2	16	0	7	1	1 full.
13	0	0	112	2	16	1	0	1	2
13	0	0	125	2	16	1	1	1	3
13	0	0	138	2	16	1	2	1	4 nearly.
13	0	0	151	2	16	1	3	1	4 full.
13	0	0	164	2	16	1	4	1	5
13	0	0	177	2	16	1	5	1	6.
13	0	0	190	2	16	1	6	1	7
13	0	0	203	2	16	1	7		
13	0	0	216	2	16	2	0	2	0

Load, $10\frac{3}{4}$ tons. Deflection, 2 inches. Permanent deflection, $\frac{3}{8}$-inch.

Experiment IV.



Length of Beam,	.	29 ft. 6 ins.
" Bearing,	.	28 " 6 "
Weight of Beam,	.	14 cwt. 3 qrs.

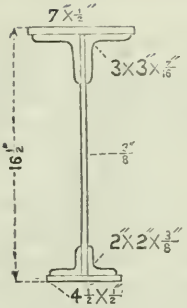
The Load rested on 22 inches in the middle of the beam.

Loading.								Unloading.								
Divisions of Load.			Load.			Deflection.		Divisions of Load.			Load.			Deflection.	
Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.	Ins.	8ths.*	Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.	Ins.	8ths.*
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3½
.	.	.	.	.	.	.	. .	5	3	8	5	3	8	0	4
17	1	24	17	1	24	0	1	8	2	26	14	2	6	0	5
11	2	16	29	0	12	0	2	11	2	16	26	0	22	0	6
11	2	16	40	3	0	0	3	11	2	16	37	3	10	0	7
11	2	16	52	1	16	0	4	11	2	16	49	1	26	1	0
8	2	26	61	0	14	0	5 nearly	11	2	16	61	0	14	1	1
11	2	16	72	3	2	0	6	11	2	16	72	3	2	1	2
11	2	16	84	1	8	0	7 full.	11	2	16	84	1	18	1	3
8	2	26	93	0	16	1	0	11	2	16	96	0	6	1	4
8	2	26	101	3	14	1	1	11	2	16	107	2	22	1	5
11	2	16	113	2	2	1	2 full.								
8	2	26	122	1	0	1	3	11	2	16	119	1	10	1	6
8	2	26	130	3	26	1	4	11	2	16	130	3	26	1	7
8	3	22	139	3	20	1	5	15	0	22	146	0	20	2	0
9	1	14	149	1	6	1	6 full.								
6	1	0	155	2	6	1	7	12	2	0	158	2	20	2	1
6	1	0	161	3	6	2	0								
6	1	0	168	0	6	2	1 full.								
3	0	14	171	0	20	2	2	12	2	0	171	0	20	2	2

*The deflections were observed to 16ths of an inch, but the 8ths only are here given.

Load, . . $8\frac{1}{2}$ tons.
Deflection, . . $2\frac{1}{4}$ inches.
Permanent deflection, . $\frac{7}{16}$-inch.

Experiment V.



Length of Beam, . 23 ft. 6 ins.
" Bearing, 22 " 6 "
Weight of Beam, . 13 cwt. $2\frac{1}{2}$ qrs.

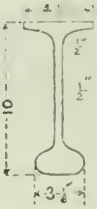
The Load rested on 21 inches in the middle of the Beam.

Loading.			Unloading.		
Divisions of Load.	Load.	Deflection.	Divisions of Load.	Load.	Deflection.
Cwt. Qrs. lbs.	Cwt. Qrs. lbs.	Ins. 16ths.	Cwt. Qrs. lbs.	Cwt. Qrs. lbs.	Ins. 16ths.
0 0 0	0 0 0	0 0	0 0 0	0 0 0	0 2
. . .	. . .	. . .	17 1 24	17 1 24	0 3
34 3 20	34 3 20	0 1	20 1 14	37 3 10	0 4
20 1 14	55 1 6	0 2	23 1 4	61 0 14	0 5
26 0 22	81 2 0	0 3	23 1 4	84 1 18	0 6
23 1 4	104 3 4	0 4	23 1 4	107 2 22	0 7
20 1 14	125 0 18	0 5	23 1 4	130 3 26	0 8
18 1 8	143 1 26	0 6	25 0 0	155 3 26	0 9
18 3 0	162 0 26	0 7			
18 3 0	180 3 26	0 8	25 0 0	180 3 26	0 10
18 3 0	199 2 26	0 9	25 0 0	205 3 26	0 11
15 2 14	215 1 12	0 10			
15 2 14	230 3 26	0 11	25 0 0	230 3 26	0 12
12 2 0	243 1 26	0 12	21 3 14	252 3 12	0 13
12 2 0	255 3 26	0 13			
13 1 12	269 1 10	0 14	16 1 26	269 1 10	0 14

Load, . . $13\frac{1}{2}$ tons.
Deflection, . . $\frac{7}{8}$ths inch.
Permanent deflection, $\frac{1}{8}$th inch.

I have as yet had only one opportunity of testing a rolled malleable iron Beam, of which the following is the result:—

Experiment VI.



Length of Beam, . . 10 ft. 9 ins.
" Bearing, . 10 " 3 "
Weight of Beam, . . 3 cwt. 21 lbs.

The Load rested on 8 inches in the middle of the Beam.

On account of some circumstances the testing was not quite so satisfactory as could have been desired, so that the observed intermediate deflections are not given. The total load, however, was ($204\frac{1}{2}$ cwt. =) $10\frac{1}{4}$ tons. The deflection was $\frac{3}{8}$ths of an inch, or perhaps $\frac{7}{16}$ths of an inch. The permanent deflection, after the removal of the load, was $\frac{1}{8}$th of an inch.

It ought to be noticed, that the loads by which the beams in the foregoing experiments were tested, consisted for the most part of railway bars, requiring two men at each end to lift them, and that in loading there was a considerable amount of concussion and vibration, so that the test was considerably more severe than that due to the mere application of the load stated.

The foregoing are the details of all the experiments I have to bring before the meeting. I do not attempt from so few cases to generalize; but in the meantime I leave them before the Institute for their consideration. I may mention, that I am inclined to doubt the accuracy of the proportions of the upper and under flanch for plate beams, as given by Mr. Fairbairn; but I am not at present in a position to speak definitely on this subject. (See Appendix.)

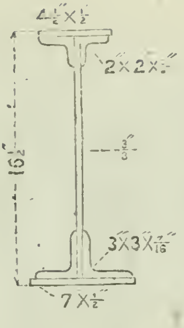
There is one remark, however, which I beg to make, before concluding this part of the paper. The flexibility of malleable iron beams, is no doubt greater than that of cast metal beams, but it is not so great as to prevent them being used for most purposes. For instance, it might be supposed that such beams were, from this cause, inapplicable to the support of walls already built, where the lower part has to be removed, as in the case of the alterations in shop fronts, which are continually being made in this city; but I may give the result of an experiment made in an alteration in Princes-street, as a case in point.

A pair of beams were used, similar to that referred to in Experiment II, except that they were 2 inches deeper, the length being 14 inches greater, and the actual bearing, when put in their place, being 16 ft. 8 ins. After the masonry above the beams had been keyed up, and the supports to the walls removed, so as to throw the whole weight of the wall above upon them, the deflection was only $\frac{1}{20}$th of an inch. I do not mean to say, that this was all the beams had yielded; but the keying up, before the supports were removed, had taken up whatever additional yielding there had been, although this must have been very little, as there was no appearance, so far as the eye could detect, of any deflection in the beams.

APPENDIX.

As already stated in the body of the paper, I was inclined to doubt the accuracy of the proportions of the upper and under flanches, as stated by Mr. Fairbairn. Since then I have made another experiment upon the beam used in Experiment V, but reversed; that is, with the large flanch, undermost, the results of which is given in the annexed table—

Experiment VII.



(Same Beam as tested in Experiment V. the larger flanch being undermost.)

Length of Beam,	.	23 ft. 6 ins.
" Bearing,	.	22 " 6 "
Weight of Beam,	.	13 cwt. 2½ qrs.

The Load rested on 21 inches in the middle of the Beam.

Loading.			Unloading.		
Divisions of Load.	Load.	Deflection.	Divisions of Load.	Load.	Deflection.
Cwt. Qrs. lbs.	Cwt. Qrs. lbs.	Ins. 16ths.	Cwt. Qrs. lbs.	Cwt. Qrs. lbs.	Ins. 16ths.
0 0 0	0 0 0	0 0	0 0 0	0 0 0	0 3
24 2 1	24 2 1	0 1	19 0 7	19 0 7	0 4
17 1 3	41 3 4	0 2	19 2 21	38 3 0	0 5
18 0 24	60 0 0	0 3	21 1 0	60 0 0	0 6
18 0 24	78 0 24	0 4	27 1 8	87 1 8	0 7
14 3 16	93 0 12	0 5 bare			
17 1 12	110 1 24	0 6	34 2 24	122 0 4	0 8
20 1 0	130 2 24	0 7			
20 1 0	150 3 24	0 8	34 2 24	156 3 0	0 9
23 0 16	174 0 12	0 9	31 3 8	188 2 8	0 10
20 1 1	194 1 13	0 10			
27 1 18	211 3 3	0 11	23 0 23	211 3 3	0 11
15 0 20	226 3 23	0 12	15 0 20	226 3 23	0 12
15 0 20	242 0 15	0 13	15 0 20	242 0 15	0 13
15 3 6	257 3 21	0 14	15 3 6	257 3 21	0 14
12 0 16	270 0 9	0 15	12 0 16	270 0 9	0 15

Load,	. .	13½ tons.
Deflection,	. .	$\frac{15}{16}$ths inch.
Permanent deflection,		$\frac{3}{16}$ths inch.

The circumstance of this being the same beam which was tested in Experiment V. and which received a set of $\frac{1}{8}$th of an inch in the opposite direction from that in which it was strained in the present instance, accounts for the apparent anomalies in the above experiment, as compared with the results of the former. Thus, at the commencement of the second testing, the beam falls more quickly than on the former occasion, while as the experiment proceeds, it seems to recover strength, and there is little difference in the ultimate strength in both cases. Again, in unloading, the beam in the second testing springs up more quickly than in the first, which is inconsistent with the idea of its being weaker, as the observed deflections imply.

An allowance ought therefore to be made for the previous set of $\frac{1}{8}$th of an inch, and the following table is probably near what ought to be substituted for that just given.

Experiment VII.—(as corrected.)

LOADING.			UNLOADING.		
Divisions of Load.	Load.	Deflection.	Divisions of Load.	Load.	Deflection.
Cwt. Qrs. lbs.	Cwt. Qrs. lbs.	Ins. 16ths.	Cwt. Qrs. lbs.	Cwt. Qrs. lbs.	Ins. 16ths.
0 0 0	0 0 0	0 0	0 0 0	0 0 0	0 1
. . .	. . .	. . .	19 0 7	19 0 7	0 2
35 0 0	35 0 0	0 1	19 2 21	38 3 0	0 3
23 0 0	58 0 0	0 2	21 1 0	60 0 0	0 4
27 0 0	85 0 0	0 3	27 1 8	87 1 8	0 5
25 1 24	110 1 24	0 4	34 2 24	122 0 4	0 6
20 1 0	130 2 24	0 5			
20 1 0	150 3 24	0 6	34 2 24	156 3 0	0 7
23 0 16	174 0 12	0 7	31 3 8	188 2 8	0 8
20 1 1	194 1 13	0 8			
17 1 18	211 3 3	0 9	23 0 23	211 3 3	0 9
15 0 20	226 3 23	0 10	15 0 20	226 3 23	0 10
15 0 20	242 0 15	0 11	15 0 20	242 0 15	0 11
15 3 6	257 3 21	0 12	15 3 6	257 3 21	0 12
12 0 16	270 0 9	0 13	12 0 16	270 0 9	0 13

Load, . . .	13½th tons.
Deflection, . .	$\frac{13}{16}$ths inch.
Permanent deflection, . .	$\frac{1}{16}$th inch.

It would have been desirable, in order to have obtained the strength of the beam, as above, without requiring to have recourse to allowances, to have used a beam which had not been previously strained by testing. This was intended in making the above experiment; but through a mistake, the same beam was used over again, and there was not an opportunity of making another experiment before the beams were sent away.

It would be very unadvisable to attempt to draw particular conclusions as to the exact proportions of the upper and under flanches, from these two experiments merely, but the results seem to warrant us in coming to the general conclusion, that for this kind of beam the flanches ought to be nearly equal, the under flanch being rather larger than the upper.

Since making this last experiment and coming to the above general conclusion, and while preparing this paper for the press, I have seen a new work by Mr. Fairbairn, entitled, "Useful Information for Engineers." In it he inserts some of the mathematical investigations of Mr. Tate on the subject, which quite agree with the statements here made. Mr. Tate concludes his remarks by saying—"The difference in the value of these constants is so small, as to lead us to infer, that the beam in Experiment 12 approaches to that of maximum strength with a given quantity of material. The sectional area of the top and bottom flanches are to each other as 14 : 15, which is very nearly a ratio of equality.

For the Journal of the Franklin Institute.

On the proper mode of Constructing an Ice Boat. By A. C. Jones.

The experience of another winter being had in channel-breaking, and the city ice boat being, like most defective things which by long familiarity grow into favor with their age, and at last are believed to be *perfect;* I holding a contrary opinion, will review some of her doings, and also offer some other suggestions in connexion with my former communication on the same subject, and I do this because there has been no more improvement made during the twenty years experience had in channel-breaking, than could have been obtained in one winter's trial. This is proved by an examination on board, and her performance in the ice.

Living within walking distance of the famous "horse shoe," I am familiar with its peculiarities, and have been more than once an eye witness of forcing a passage through it, and, with all due deference to the opinions of others, I do not consider it so very formidable, or if I am mistaken, how is it that the ice boat got so soon through "ice packs, 6, 8, and 10 feet above, and 10 to 12 feet below the water surface"* with the thermometer nearly at zero, and yet, on the 10th of February, (20 days later,) made such poor time from Greenwich point to Kaighn's point, and thence to the Navy Yard, where there was none of these *eighteen to twenty feet thick masses of ice*, and what ice there was, had been softening from January 26th, by thaws every day, and on two days much rain fell. An article in the *Public Ledger*, eulogistic of the ice boat bears me out in what I incidently touched on before; on "January 9th a drag link broke—on the 12th a crank broke," (both requiring 4½ days to replace) "and much time was lost in prying the engines off their centres, once having to send to the city for jacks-screws for that purpose;" if *properly* constructed friction couplings had been in use, neither of these breakages would have occurred, and as the engines could with ease be coupled either at half stroke, or at any other point, while in motion, *without any shock*, all this labor and ado about getting the engines off their dead points, (*which is a common thing in ice breaking*,) would have been saved. Again, "the broken ice in the way of her next effort, was found to interfere so much with her progress, by breaking the force of her onset," that the boat was laid by until the *tide turned, so as to float it out of her way.*

Much might be written on auxiliaries to ice breaking, as stamping; blasting, butting, the battering ram, running up on the ice and breaking it down; they are *all* good under certain circumstances, and if at hand their use would be proper. I protest against one principle being carried out and considered perfect, when no other plan has been tried on the river even by experiment.

By an oversight I omitted to state in the paper published before on the

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* If this boat passed so quickly through such formidable masses of ice, Mr. Grinnell made a great mistake in not securing her services for the recent exploring expedition, as by doing so, the solution of a "North-West Passage," would not have long remained in doubt.

"rooting" plan, that the stem of the boat *below* the point of the ridge, could be either vertical or at an angle, and of course the "butting" principle could be carried out when required in packed ice.

Power may be wastefully employed, and it carries with it increased expense.

I am satisfied of the correctness of the position, that sheet ice, (which is $\frac{4}{5}$ths of the work) *can be broken upwards by an inclined ridge or planes, with the least consumption of power;* and that the ice so broken *should be put out of the channel*, as it is well known that broken ice will become in a short time as compact as before, and herein lies one of the objections to relying on the butting principle as now practised, for the floating cakes not only clog the hull and wheels, but remaining floating in the channel freeze together, and the same work has to be done over again, and again.

Now, suppose we use below the point of ridge, a vertical stem, or have it at an angle, (the bow would then present lines all running to a point >,) and heavy packed ice is met; the boat has prepared a clear channel to *back in*, (the broken ice having been sent over the sheet ice out of the way,) and the boat is "butted" up against the mass crushing and breaking a portion of the ice, that above will be forced sideways; the boat is backed, and again runs up, and the loose fragments floating are forced up the inclines and are thrown off before the impetus of the boat is checked, and this, the severest duty of the boat, can be best performed with the tide.

If such a boat was in existence, I would not have the Philadelphia custom of allowing the river to be a month frozen before operations are begun, but as soon as the ice was of a sufficient thickness, then break from the Navy Yard down the river a single channel and *no more*, (except the ice was moving,) and keep plying to and fro in *that channel*, having depots of fuel at points on the river, not as at present, when the boat should be at work below Chester, to be compelled to come back to the city for fuel, and thus give "Jack Frost" time to add to the thickness and cement the broken mass.

With this plan put in operation then, the famous "horse shoe" would lose part of its troublesome character, which it obtains by the broken pieces of ice carried by the tides, which naturally packs in the "bights" of the river, and there freezes into compact masses. Of course towing should not be the duty of the boat, except to assist the "tugs" as a pioneer in difficult places. As a boat for ice breaking is required but for a fraction of the year, to make the same boat productive she must be used for towing, and of course, a bow proper for the former purpose would be objectionable for the latter. Suppose we should take a hull modelled for towing; a "plough or rooter," carrying out the principle I have explained, can be attached to the bow of this boat, (something like the "snow plough" to a locomotive engine,) or any other boat having sufficient power, and she becomes an efficient ice breaker for either "sheet" or "pack ice"—and in one day after her services are not required for such duty, the plough can be removed, and then the boat can be employed as a tow boat, &c. The plough to be attached again the next winter to break a channel.

I claim for the plans suggested as compared with the present ice boat,—

1st. Much less risk of breakages, and their consequent delays.

2d. Less power required to break sheet ice, and consequently economy.

3d. Keeping an open channel by removing the broken ice from it.

4th. Greater power and facilities for butting.

5th. An equal utility as a tow boat, when not required to break ice.

6th. And the power to *widen the channel* by cutting the ice on one side, sending the broken ice over the solid ice, out of the way of the open channel.

Astronomical Expedition to the Peak of Teneriffe.[*]

(Continued from page 189.)

Closely connected with radiation is the quantity of the light emitted by the heavenly bodies, and this was examined frequently in the case of the sun and moon and different parts of the sky by observations of Trauenhofer's lines in the spectrum. Stoke's spectrum was also examined, as recommended by the Royal Society, and was found to be traceable beyond the furthest point previously ascertained elsewhere. Means of photographing this spectrum, were also prepared, and some pictures of it, on glass, obtained, showing many of the dark lines beyond H, the usual limit of vision.

Several hundred measures of the polarization of the sky-light were likewise obtained, and the zodiacal light and twilight were frequently made the subject of numerical observation; continual registers of the barometer, dry and wet bulb thermometer, and the electrometer, being kept up during the whole of the time.

The geology of the peak could be well examined from this point, and offered much of exceeding interest, as did also the magnetism and botany of the neighborhood, while the remarkable moderation of the wind, considering that it was a mountain top, allowed researches to be carried on without let or hindrance throughout the twenty-four hours.

On the whole, therefore, Guajara approved itself admirably as a station for ascertaining the astronomical qualities of the atmosphere at the height of 8870 feet; but still, Professor Smyth could easily see that he had by no means reached the *ne plus ultra*, and might evidently effect even far greater improvement by rising yet higher above the atmospheric impurities that linger about the surface of the earth. "Raised we were," he says, "far above the level of the actual cloud of the N. E. wind, but we were not always above the wind itself; and even, as this rose and predominated over the station, so did telescopic definition become bad. We were also more frequently than otherwise, enveloped in a dusty, smoky sort of medium, whose vast strata piled one on the other, and stretching out to the distant horizon, rose some thousands of feet above our heads, and only the peak itself seemed high enough to be fairly above these upper mists. To the peak, therefore, it was evident we must go to reap all the astronomical advantages which Teneriffe is capable of yielding.

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[*] From the Lond. Mech. Mag., November, 1856.

The peak, however, was not so simple a matter to reach as the first station, for the top is not accessible on account of the constant evolution of sulphurous vapors, while a considerable portion of the slope below it, is impracticable on account of the broken lava-streams by which it is covered. The time also being short, while himself still observing at Guajara, the Professor sent men to explore the ascent, to ascertain the highest available station, and to build the walls of a scientific encampment, according to a plan furnished them. Then, on the 28th of August, the party moved over with all their instruments mounted on a train of twenty-seven horses and mules; and after a day's hard work, toiling through the pumicestone soil and rugged lavas of the old crater, and after a long steep climb, occupied before night their new position of the Alta Vista. "Perched on the top of a ridge of pumice and red lava on the southeast slope of the Peak, at an elevation of 10,900 feet, the Alta Vista forms," says Professor Smyth, "a comfortable little shelf, tolerably level, and is the highest point accessible to mules. On no other side can they ascend so high, by reason of the torrents of black lava blocks, which there cover the flanks of the mountain, but which have in this case curiously divided, and left a narrow and steep roadway of the older rock between two embankments of the newer scoria. These ridges, rising to the height of about thirty degrees, served admirably to protect us from the wind towards the S. W. and N., and, if they did interfere with the ruder eye observations of some phenomenon near the horizon, they contributed to the advantage of telescopic observations with high magnifying powers directed to the zenith. Here, therefore, was the place where the great Pattinson equatorial must be erected, if at all."

On the 25th of August, after the elevation of this instrument had been pronounced by his friends as hopeless, the indefatigable Professor, leaving the men to roof in the newly built walls, descended the mountain to see what could be done in carrying it up. This instrument, with an object glass of 7¼ inches aperture and 12 feet focus, and with an equatorial mounting entirely in metal, and of the first class of finish and perfection, in accordance with the requirements of modern astronomy, had been taken to pieces by its maker in England, as far as he had thought safe or practicable for its re-erection on a mountain side, far from the resources of workshops. But as he had not reduced it to its primitive elementary parts, the unwieldier masses could still be subdivided and packed up into smaller parcels. To this, therefore, Professor Smyth applied himself, and, assisted by an ingenious mechanic of the place, separated, and finally packed in 13 boxes what had been arranged by the maker in three. Then starting from the town at daylight on the 30th of August with 11 horses and men, the whole of the cases were taken up to the Alta Vista by sunset the same evening. On the second day, notwithstanding a storm of wind and sand which raged for the two days, the complete equatorial, with clock motion, axes well adjusted, and verniers reading off accurate places on finely divided circles, was in full operation, the first time that such a thing had ever taken place so high above the level of the sea.

But now only a fortnight of the prescribed time remained, and there were marked indications of the premature breaking up of the fine season. Professor Smyth set to work, therefore, without loss of time to determine, in the first place, the degree of definition in the atmosphere; for very grave fears had been thrown out that the hot vapors from the Peak would be utterly fatal to telescopic vision. The definition, however, proved admirable; so much so, that not only once, but every night for a week, he could see that difficult test B and C of γ Andromedæ as two distinct stars; nor could he find any object in the lists of the "Cycle" that were not separated by the telescope, and with ease.

Equally with regard to the range or visibility did the atmosphere approve itself; for the very faintest star to the practised eye and powerful telescope of the observer of the "Cycle" proved easy to even an inexperienced person in the Pattinson equatorial.

Directing them to planetary bodies, the fine division of Saturn's ring —a much contested matter—came out unmistakably, and revelations of clouds appeared on Jupiter's surface, which were eminently smaller in form, and as continually interesting in their changes as those of the sea of lower clouds brought about Teneriffe daily under their eyes by the N. E. trade winds. Of the moon, some extraordinary views were obtained, notwithstanding its unfortunately low altitude at that time, and the sun was observed both optically and photographically.

Daily, however, the weather, which had been in a manner disjointed by the storm on the 1st, was becoming worse; and the wind continually increasing, now began to shake the telescope so as to prevent the employment of high magnifying powers. Then the sky became cloudy; and at last, on the 14th of September, the storm broke in earnest, beginning with a rattling fall of hail.

"That night," says Professor Smyth, "above two inches of rain fell, and the climate altered so much that the natives would no longer remain with us. But the temperature was by no means unbearable to Northern men, and the sailors from Mr. Stephenson's yacht, proving good men and true, I still hoped to be able to see out the last of the clouds, and to finish several series of observations which had been interfered with by them. The break up of the summer weather had, however, been too complete, and though we stayed till the last possible day, we never saw the clear sky again; so, on the 19th, we dismantled the buildings, made a *caché* of such materials as might be useful in a future year, and went down to Orotava with the instruments and baggage."

During the Alta Vista period of these experimental labors, the smaller instruments before employed at Guajara were again in action; an improved method of observing the black lines in the spectrum was devised; some meteorological ascents and descents of the mountain were made, according to the suggestions of the Royal Society; and Humboldt's horizontal fluctuation of the stars, and the nature of the ice cavern, as recommended by Sir J. Herschel, were examined into. The crater of the Peak, the Montana Blanca, and various places remarkable for their geology or botany, were visited with hypsometric instruments, and with a photographic camera, by the aid of which about 200 pictures were obtained.

Finally, in concert with a Spanish gentleman of great local knowledge (Don Martin Rodriguez, of Cegas), the Professor examined the upper part of the mountain, and found a station that, with a little expense, might be made available for another year, and besides greater height, would possess some other advantages over either the Alta Vista or Guajara. Arrived in Orotava, he employed himself for a week settling the accounts, in examining the zeros of his meteorological instruments, and in photographing and measuring some remarkable volcanic features in the neighborhood, and also the great dragon tree, as recommended by Sir John Herschel. Then on the 26th of September he rode over to Santa Cruz, and having examined the tide gauge which, with the assistance of Mr. Hamilton and the warm co-operation of the Spanish engineers, he had had constructed on the mole, to meet the wishes of the Master of Trinity College, Cambridge, he embarked on board the yatch *Titania* the same evening. The captain immediately set sail, called off Orotava the next day, September 27th, for the instruments and baggage, and has now safely brought them back to England, after an absence of 117 days. Of these 36 have been spent at sea, 18 in the low lands of Teneriffe, 37 at the height of 8870 feet, and 26 at the height of 10,900 feet.

Translated for the Journal of the Franklin Institute.

Simple Electric Machine.

M. Thore united the ends of a strip of paper about 8 inches in width, so as to make a continuous band of it, and stretched it on two wooden pulleys covered with silk, one of which was rapidily turned around by a handle ; the electricity was developed by pressing a warmed flat-iron upon the paper as it passed over one of the pulleys. He describes the effects as remarkable.

There is nothing new in the observation of the electricity developed by paper, and many of our machinists have noticed how often the bands of their machinery became electrically charged. But the apparatus is simple and cheap, and capable of working under atmospheric conditions which arrest the action of our ordinary machines.—*Academy of Sciences* (Paris), May, 1856.

Simultaneous and Oppcsite Electric Currents in the same Wire.

M. Petrina has investigated this disputed phenomenon by means of the reduction of temperature which Peltier discovered to take place when an electric current passes from bismuth to antimony. A metallic bar of these two metals soldered together in the middle, was introduced into the bulb of an air-thermometer, and divided currents from the same battery carefully equalized, were passed through it in opposite directions. In this case, if no current passes, no effect should be produced ; but if both pass, since the cooling effects are known to be much less than the heat produced by the same current when passing in the opposite direction, the thermometer should indicate such heat. In fact, no effect was produced when the currents were equalized, and when they were allowed to be unequal, the heat was that due to the difference of the currents.—*Cosmos*, July, 1856.

Extraction of Sugar from the Juices of Vegetables.

M. Maumené (*Ann. de Chim. et de Phys.*, Sept., 1856), after recalling the well established fact, that a cold solution of sugar gradually changes from cane sugar to grape sugar, and showing that this is the case even when the juice remains in the vegetable, and that hence, a very notable proportion of sugar is lost in manufacture, proposes to remedy this evil by adding to the expressed juices rather more than half the weight of the contained sugar, of slacked lime in powder. His experiments on a small scale, and the application of his method by manufacturers of beet sugar, seem to establish the applicability of his process, which may be of great value to the owners of our sugar plantations.

For the Journal of the Franklin Institute.

Particulars of the Steamers Galveston and Opelousas.

Hull built by J. Simonson, New York. Machinery by the Allaire Works, New York. Owner, C. Vanderbilt, Esq. Intended service, Berwick Bay to Galveston, Texas.

HULL.—

Length on deck,	236 feet.
" at load line,	230 "
Breadth of beam (molded),	37 "
Depth of hold to spar deck,	12 " 3 inches.
Draft of water,	6 " 6 "
Tonnage, hull and engine room,	1000.
Area of immersed section at load draft,	210 sq. ft.
Masts—two—schooner rigged.	

ENGINES—Vertical beam.

Diameter of cylinder,	41 inches.
Length of stroke,	12 feet.
Cut off—at one-half.	

BOILER—One—Return flued.

Breadth of boiler at furnace,	14 feet.
Diameter " "	10 " 6 inches.
Height " exclusive of steam chimney,	10 " 6 "
Number of furnaces,	three.
Breadth "	4 " 2 "
Length of grate bars,	6 "
Number of flues or tubes,	above, six—below, four.
Internal diameter of flues or tubes,	16¾ "
Diameter of smoke pipe,	4 " 5 "
Height " "	40 "

WATER WHEELS.—

Diameter over boards,	30 feet.
Length of blades,	6 " 6 inches.
Depth "	2 "
Number "	twenty-six.

Remarks.—Date of trial, March, 1857. Frames, *molded*, 15 inches, *sided*, 12 inches; 24 inches apart from centres, and strapped with diagonal and double laid braces, 4 × ½ inch. Depth of keel, 6½. One independent steam, fire, and bilge pump. Boiler, chimney and smoke pipe protected from communicating fire by felt and sheet iron. Has a light deck over main deck, which is enclosed at sides. C. H. H.

On a Mode of Giving a Metallic Surface to Horn.[*] By M. Meunier.

The articles made of horn are first prepared as usual, and then coated with chloride of zinc, either by immersion or with a brush. A yellow bronze color is produced; chloride of copper gives a blackish-bronze, chromate of copper a brown-bronze, and chromate of zinc a green color. Iodide of potassium, applied over any of the copper colors, renders them red. The objects soaked with the solutions of these salts are exposed to a temperature of 154° F., and rubbed after drying, with a mass composed of 5 parts of mercury, 15 parts of tin, 3 parts of sulphur, and 5 parts of muriate of ammonia, in the preparation of which the mercury and tin are first combined into an amalgam, which is then powdered and mixed with the other substances. The objects are then heated in a flask in the sand-bath until the mercury is evaporated, and a yellow mosaic gold is obtained.—*Polyt. Centralblatt*, 1856, p. 574.

Accident to the Dover Submarine Cables.[†]

An accident happened to the submarine line across the Channel, and telegraphic communication with the continent was temporarily delayed in consequence. During the fearful gales on the 5th inst., a ship of 700 tons, heavily laden, lost her anchor in the Downs, and, driven by the force of the gale and tide, fouled a schooner; she then, becoming more unmanageable, drifted into five fathoms water. An anchor was speedily let go, with 40 fathoms chain attached; but the barque, still impelled by the unusual force of the gale, dragged her anchor until she was brought up sharply, head to wind, on opening the western light of the South Foreland. It is feared that she here came upon the Submarine Company's Ostend Cable. The hurricane, the tide, the weight of the ship, and the necessity for keeping her foretopsail aback to drift into deep water, worked so much upon the submarine line that, after holding her for some length of time, the cable giving way, she instantly swung round before the wind, and was careering forward with increased velocity, when she was suddenly brought up, head to wind again, by the Calias cable. The barque was held, in spite of the heavy sea, the gale, and the pressure of the wind on her sails, for about an hour, when once more she broke away, and sailed off down the Channel. Both submarine lines unfortunately became unworkable in consequence of this untoward accident; and communication with the continent was partially stopped. The sea at the point where the vessel caught the cables is about 14 fathoms deep only, and the spot is within three-quarters of a mile from the shore. The company have already made arrangements to repair the cables the moment the weather will permit; and, meantime, messages are being telegraphed to Dover, sent thence by the steamer, which leaves thrice daily, to Calais, and are from Calias telegraphed to their various destinations. It is supposed that, the weather proving favorable, both cables might be completely repared in the course of a day.—*Times.*

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[*] From the Lond. Chem. Gaz., No. 335.

[†] From the Lond. Artizan, Feb., 1857.

Electric Conducting Powers of the Metals of the Alkalies and Alkaline Earths.

Dr. A. Matthiessen has made, under the direction of Prof. Kirchhoff of Heidelberg, a series of experiments on this subject, the method of performing which, is fully described in the *London, Edinburgh and Dublin Philosophical Magazine*, for February. The following are the results. The temperatures are in centigrade degrees.

The conducting power of silver at 0° being = 100.

That of	Sodium	at 21·°7	=	37·43
	Magnesium	17·	=	25·47
	Calcium	16·8	=	22·14
	Potassium	20·4	=	20·85
	Lithium	20·	=	19·00
	Strontium	20·	=	6·71

The potassium and sodium used, were commercial; the others were obtained electrotypically. Experiments were also made, and are reported in the original paper, on the variation of the conducting power by heat.

In these results an interesting fact was observable, viz: that at some distance from the point of fusion, as well in the liquid as in the solid state, the decrements in the conducting power with the increase of temperature were almost in proportion, but near the point of fusion the decrease in the conducting power became much more rapid; with sodium this change appears to be very sudden, whereas with potassium it seems gradual. This difference in these metals corresponds with their different behavor in fusion; namely, potassium does not become suddenly liquid like sodium, but first passes through a semi-fluid state.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, March 19th, 1857.

John Agnew, Vice President, in the chair.

B. Howard Rand, Recording Secretary, P. T.

A letter was read from the Virginia and Tennessee Railroad Co.

Donations to the Library were received from the Astronomical Society of London, and Charles Wye Williams, Esq., London; L. A. H. Latour, Esq., Montreal, Canada; Hon. James Dixon, U. S. Senate; Hon. Job R. Tyson, U. S. Congress; Lieut. I. M. Gillis and Prof. A. D. Bache, Washington City, D. C.; University of Michigan, Ann Arbor, Michigan; Mercantile Library Association, St. Louis, Missouri; Young Men's Mercantile Library Association, Cincinnati, Ohio; The Virginia and Tennessee Railroad Co., Lynchburgh, Va.; The Maryland Institute, Baltimore, Md.; Robert C. Walker, Esq., Harrisburgh, Penna.; and Messrs. T. Y. Medlin, James D. Rice, Prof. J. F. Frazer, Trustees of the Philadelphia Gas Works, and the Mine Hill and Schuylkill Haven Railroad Co., Phila.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer's statement of the receipts and payments for the month of February was read.

The Board of Managers and Standing Committees reported their minutes.

The Actuary reported that the following Standing Committees for the present year, have organized by electing their Chairmen and appointing the times for holding their stated meetings.

Committees.	*Chairmen.*	*Meetings.*
On the Library,	James T. Lukens,	1st Tuesday Evening.
" Exhibitions,	John E. Addicks,	1st Thursday "
" Arts & Manufactures,	James C. Booth,	1st Friday "
" Meteorology,	Alfred L. Kennedy,	2d Monday "
" Science and the Arts,	John C. Cresson,	2d Thursday "
" Meetings,	Washington Jones,	Monday previous to 3d Thursday.

Candidates for membership in the Institute (4) were proposed, and the candidates proposed at the last meeting (4) were duly elected.

Mr. F. Peale exhibited samples of a new valve for which Letters Patent of the U. S. had been granted to him, and explained its construction and form, being an imitation as nearly as possible by human hands of the valves of the arteries and veins of the system.

He stated what he believed were the advantages possessed by these valves, and although applicable to any purpose to which ordinary valves are applied, they are particularly so to elastic and flexible tubes, in which form they were presented to the attention of members of the Institute, and showed that they occupied no more space than the diameter of the tubes in which they were placed, were extremely simple and easy of construction, and therefore economical; that they were not liable to derangement; would bear the roughest treatment, which was exemplified by beating, bending, and even treading upon them, and would work equally well in any position. He also stated, that being made of the same material as the tubes themselves, that is, vulcanized gum elastic, they could not be injured by any agent that would not destroy that material, and finally exhibited the action of the valves in syringes, in a very satisfactory manner.

Mr. Jones submitted the plan of joining the ends of leather belts by means of hooks which was discussed, and samples of the hooks shown. They are made of cast iron wire flattened between rollers, and cut to lengths, when the ends are turned over towards each other. In this state they resemble links of a chain, having the straight part of one side cut away.

When a belt is to be joined, holes are punched at proper distances from the ends, the hooks inserted, and then closed by a blow from a hammer. The plan is a simplification of lacing or joining by wire, and seems to be superior, as the joinings can be made in less time and with less material. When the belt needs shortening the hooks must be cut, and cannot be used again, but the loss is small, as they can be supplied very cheaply.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

MAY, 1857.

CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

On the Cause of the Frequency of Fire occurring on board of Steam Vessels of all Descriptions. By Chas. H. Haswell, C. E.

To the Mechanics' Club of the American Institute, New York.

New York, January 31st, 1857.

In consequence of the frequency of fire occurring on board of steam vessels of all descriptions, I deem it proper to address you upon the subject, for the purpose of inviting your attention thereto, and at the same time submit to your consideration the following recital of the principal causes therefor, and also some observations regarding the proper measures which, in my opinion, should be resorted to, to arrest or remove them.

Neglect of Security and Provisions against Fire on the part of the Constructors and Owners of Steam Vessels.

Boilers.

1. *Boilers with external furnaces*, alike to the ordinary cylindrical boiler of the Western and Southern waters, are supported by iron standards; the sides of the furnaces and the bottoms of the lower flues, being constructed with brick work and mortar beds, and in the construction of this work, care is given more to the general confinement of the fire and flame for the economy of fuel, than it is to guard the vessel from being fired. When boilers of this description are used, even on land, it is impracticable to keep the brick work and bedding permanently free from fissures, whereby fire or sparks may pass out and ignite any inflammable material they may come in contact with; how much more difficult then,

must it be to keep brick work free from fissures, when it is subjected to the workings and concussions of a steam vessel.

2. *Boilers with internal furnaces*, alike to the ordinary marine boilers, are frequently constructed without water bottoms, hence, when the fittings of the legs to the bed of the boiler is imperfect, either by neglect in the workmanship, or may become so by the effects of rust, an opening is exposed, whereby fire or sparks may pass out, as in the case just recited.

3. *Boilers, the furnaces of which are fitted with blowers, to afford an artificial draft.*—In this case the pressure of air within the furnace, flues, and pipe, being superior to the external atmosphere, any fissure or hole in any part of the external face of the furnace, the fitting of the legs of the boiler to its bed, (when there is no water-bottom,) the fitting of the man-hole doors or flue-stoppers, and the fitting of the smoke pipe to the chimney, becomes a ready vent to fire or sparks which are driven out with great velocity, when the blast is high, and which falling upon, or adhering to, any inflammable material they may come in contact with, the risk of igniting it, is incurred thereby.

Coverings and protection to boilers.—It is very rare to find that the boilers of any of the Lake, River, or Sound steam vessels, are covered with felt (of hair), for the double purpose of protecting the wood work around them from fire, and for the economy of fuel. This very effective precaution against fire, is scarcely known amongst the class of steamers referred to, whilst its use in the sea-going service is almost universal, the utility of it being recognised, in restricting radiation of heat, from the boiler to the engine room and cabins of the vessel, and in its economy of fuel: although at this time there are many owners of steamships, who pertinaciously refuse to resort to this means of effecting economy of fuel, comfort to the passengers and crew, and of reducing the risk by fire, merely because it involves an immediate expenditure of money, and because the engineers of the vessel, in common with a large majority of the profession, always oppose any means calculated to save life, property, and fuel; consequently they do not urge upon the owners of their vessel, the propriety and necessity of this provision.

As a security against fire from being communicated by an over-heated boiler, a covering of felt is of the first importance—for the reason, that immediately upon its being burned, the peculiar odor of its combustion is readily recognised, the engineer and firemen upon duty at once know that the felt around the boiler is being burned; their attention is forthwith drawn to the circumstance, and if it has arisen from an over-heated boiler, or from fire being communicated through a hole or fissure, it is readily discovered, and remedial measures resorted to.

Covering and protection to wood work around boilers.—In our Lake, River, and Sound steamers, it is very rare to meet with any covering as a protection from heat or fire to the wood work contiguous to a boiler; the neglect of this essential point is so general, as almost to be deserving of being classed as universal, and as the occurrence of fire, originating around a boiler, is not restricted to one cause, but may arise from so great a number, it is difficult to account for the continual neglect of proper precautions upon this point.

The cases in which the wood work around a boiler is exposed to being fired are,

1. When the water in a boiler has been allowed to fall below the flues, the shell and steam drum or chimney, as the case may be, become sufficiently heated by radiation from the superheated steam within, to effect ignition of wood work immediately exposed to it.

2. When water has been allowed to fall below the flues as just referred to, and the occurrence is discovered, it is customary, immediately to haul the fires from out of the furnaces, into the fire room, and when the wood work immediately over and around the fire room is not properly protected, fire is likely to communicate to it, and fires from this cause have frequently occurred.

3. When blowers are used, the fire or sparks that may be blown out through fissures in the furnace doors, ash pits, flue holes, chimney connexions, &c., will readily ignite wood already at a high temperature and quite charred, from having been before exposed to such temperature.

Chimney Jackets and Rooms.—In single decked steamers, when the boiler is below, and the steam chimney is above the main deck, or when the boiler is on the main deck or upon the wheel guards, it is customary in many cases, to cover the chimney or chimneys, as the case may be, with a wooden casing, set off from it but a few inches, and in others to cover it with a sheet iron jacket, in most cases imperfectly made, and in all, insufficiently fitted. In steam vessels with two or more decks, the boiler or boilers being in the hold, the steam chimney and the base of the smoke pipe are commonly enclosed in wood work alone, which is in some cases set at a proper distance from the chimney, to avoid the risk of it being fired by sparks or the continued radiation of heat from it, but the purpose of this space is very frequently negatived, by its being used for the storage of swabs, buckets, brooms, &c., &c.

This wood work, however, is very seldom properly protected, in many cases no protection at all is attempted ; in some a coat of whitewash is laid on, and in others a lining of tin, zinc, or iron, in which the laps of the sheets are laid downwards, as if they were there placed to shed rain or water falling from above, instead of fire arising from below. The tin, and even the zinc, unless well nailed, are too light, and their expansion at high temperatures too great for this purpose: the consequence is, that when subjected to the heat of the smoke pipe, they wrinkle and spring to such a degree, as not only to admit any sparks that may arise up from below, to pass between their laps and under them to the wood, but the sparks are liable to be arrested there by the inequalities of the surfaces, where they are exposed to a draft of air which readily effects an ignition of the wood, and when this is discovered, the presence of these sheets prevents the immediate application of water to the fire underneath them, and before they can be removed, the flame has passed through the joints or crevices of the light wood work around the chimney and boiler, and the whole is in full combustion.

In other cases this wood work around the steam chimney or drum, is placed close to it, precluding the proper circulation of air, and not affording the necessary room wherewith to cover the wood with any material, or even to whitewash it, and when fire is communicated to this work, fitted by its character and position for ready combustion, it is in the most favorable condition therefor, and when ignited it requires but an instant for it to be developed, beyond the control of the means usually found in steam vessels.

Deck loads.—It is a common occurrence for the main deck of our Coast, Lake, Sound and River steamers to be so encumbered with freight, that not only is a great risk incurred from fire being communicated to the freight when combustible, but in the occurrence of fire, the presence of this freight is an obstruction to the means necessary to be resorted to, to extinguish it.

Store and Tool rooms.—These are other and prolific sources of fire on board of steam vessels, rendered so by their being appropriated to the storing of oils, paints, turpentine, (the latter frequently in packages of glass,) wiping stuff, either of loose hemp or cotton waste, packing yarn, cotton wick, matches, &c., &c., which in a large majority of cases are not properly stowed, but from the carelessness of those who visit these rooms, articles alike to the above recited, are scattered about and constantly exposed to be ignited by the upsetting or falling down of a lamp or candle. In steamers with two decks, the boiler or boilers being below, it is by no means unusual to find a part of the space immediately over the boilers allotted to a store room for the engineers' department, for the reason that being unsuited by its high temperature for ordinary purposes it is not objectionable on that account as an engineers' store room, added to which, it is declared to be very convenient to the engine room, and the propriety of the location is thus confirmed; the result of which practice is, that upon the upsetting of an oil can, or the breaking of a glass vessel containing spirits of turpentine or paint oil, the top and sides of the boiler beneath are flooded with an element of combustion, which rarely if ever fails to cause the destruction of the vessel.

Pumps.—In the construction of an engine for a steam vessel, it is usual to attach an ordinary lifting pump, of a capacity calculated to free the vessel from the drips and vents of water from the engine and boiler, and from the ordinary leaks of the hull. This is also arranged so as to be worked by hand when the engine to which it is attached is not in operation, and it is usual also, to connect to the feed pumps of the boiler, an air vessel by which it may be made to project water, and thus be used as a fire engine, and until the introduction of the independent steam fire engine and bilge pump of H. R. Worthington, within the last ten years, no other means were depended upon to free a steam vessel from water, or furnished it to arrest a fire.

With these details, then, of the numerous causes of fire on board of steam vessels, and of the imperfect means to prevent or arrest them, I now proceed to recapitulate the several causes here referred to, and to suggest such measures as, in my opinion, should be resorted to, by the owners of steam vessels at this time, and builders of them hereafter, by which this class of disasters may, to a great extent, be averted.

NEGLECT OF SECURITY AGAINST FIRE.

1. *Boilers with external furnaces* should be supported by iron standards alone. The sheet or plate iron, as the case may be, which encloses

the masonry should be accurately fitted in its joints, and under no circumstances should the wood work around the boilers be allowed to be within one foot of them, their upper surfaces being well covered with felting of hair, and the under side of the wood work immediately over them sheathed with zinc or sheet iron ; the nails securing which to be in squares not more than one and a half inches apart, and the laps of the sheets to be secured at every half inch.

2. *Boilers with internal furnaces*, should have water bottoms in order to guard fire from being communicated to their beds through openings therein, and when a natural draft is used for combustion, the exhaustion within the furnaces, flues, and pipe, is such as to cause a current of air to lead into and through any apertures opening to them, and hence fire or sparks are prevented from being emitted through any of the ordinary openings or joints about a boiler ; but where a blower is used, the conditions are entirely different. The pressure of air within the furnaces, flues, &c., is so great, that fire, sparks, and even small pieces of ignited coal will be forced through any openings that may exist, and as it is impracticable to construct a boiler without a number of insecure openings, such as those of the furnaces, ash pits, and flue doors, smoke pipe joints, &c., fire is constantly being forced out through them, and a great number of steamers have been destroyed from this cause, added to which, the momentary firing of them from this cause is a matter of so very frequent occurrence, that if the public at large were fully aware of the risk of life they incurred in traveling in steamers where blowers are used, the abandonment of all such vessels would be so universal, that the owners of them would be compelled to remove this risk forthwith ; their interest in this inducing their attention thereto more effectually than any law that might be enacted to reach them. So opposed to all propriety is the use of blowers, and so essentially necessary to the requirements of personal safety is the abandonment of them, that I question if a jury, composed of intelligent persons, with the facts fully before them, could be found throughout the entire country, that would not decide that a vessel in which they were used was unsuited to carry passengers, even on a river or sound, and unseaworthy on a lake or the ocean.

3. *Covering and protection to boilers.*—All boilers should be covered with a hair felting, both for the purpose of indicating when they are unduly heated, and as a means of preventing the radiation of heat from the boiler to the wood work around it. So well established are the advantages of felting boilers, both for the economy of fuel, security against fire, and comfort to a crew, with all engineers—and I wish to be understood as not using this term to include mere drivers of engines—that in some of the Atlantic, and in all Naval steamers, the felting of twice and thrice the ordinary thickness is used, added to which are fitted over it coverings of canvass and sheet lead.

NEGLECT OF PROTECTION TO WOOD WORK AROUND BOILERS, THEIR CHIMNEYS AND SMOKE PIPES.

1. *Protection to wood work around boilers.*—The wood work immediately around a boiler, its steam chimney or drum, should be set off

from it as far as it may be practicable, consistent with the capacity of the vessel; thus, when a boiler is in the hold of a single decked vessel, it is not practicable to afford much space between its top and the under side of the deck beams above it without making a break in the deck, a measure not always consistent with the requirements of the vessel; neither is it desirable when the boilers are upon the guards of a steamer to construct a covering to them of a sufficint height to secure it from being fired by radiation of heat from the boiler. Neither is it imperatively necessary that there should be any great distance between a boiler and its surrounding wood work; one foot is a desirable distance, and even more would be preferable, but when blowers are not used, and a boiler is properly covered, the wood work around it if properly protected may be set within six inches of it with safety, and all wood work about a boiler, as well as the top and sides of the fire rooms, should be covered with sheet iron or zinc, secured in the manner already detailed, with the further precaution of placing the laps of the sheets upwards. When a metal covering is not used, several coats of thick whitewash, stiffened with a little glue, will answer a good purpose; in fact, I think this preferable to coverings of tin or zinc as they are usually put on.

2. *Protection to wood work around steam chimneys and smoke pipes.*—Chimney rooms should be afforded a space sufficient to admit of the passage of a man around the chimney, and should be without any floor, so as to furnish a free communication for the escape upwards of the heated air from around a boiler, and also to admit of the introduction of a hose pipe in the event of the wood work around it being ignited. Whenever a smoke pipe passes through a deck, however light its character, there should be an open space around it to admit of a current of air to pass through it, and between this space and the wood work there should be a metallic boxing containing water to guard the wood from ignition.

WANT OF PROVISIONS AGAINST FIRE.

Pumps.—Where security from fire is imperfect a greater regard to the provisions against it should be had; this requirement, however, is not observed, and the disregard to the safety of human life, and the interests of the underwriters, which so generally exists, is observable in the want of provisions against fire, as in the other points referred to.

All steam vessels should be provided with an independent steam fire engine and pump combined, and all sea-going steamers of magnitude should be provided with two, and an independent boiler to work them; fitted to these pumps there should be a sufficiency of hose (in good order) to lead to any part of the decks or hold; added to which there should be the proper number of hand fire pumps upon the upper deck of the vessel, with hose sufficient in length to reach to any part of the vessel forward or aft, according as the pumps may be located forward or aft, and which hose should be so fitted as to be capable of being attached to the hose of the engine pumps. Further, the provisions of the U. S. Law of 1852, regarding the carrying of fire buckets and axes should be rigidly enforced, and a non-compliance therewith should be held to be a forfeiture on the part of the owners of a vessel that was burned to any claim for loss on the Underwriters.

As many owners of steam vessels will think this suggestion of even one independent steam pump and a boiler, a requirement altogether unnecessary, and imposing too great a burthen upon them; they will be surprised to learn that I can support my views by a reference to the fact that most of the sea steamers belonging to this port are fitted with pumps of this character, and that many have two of them, and an independent boiler to operate them; further, that rarely does a month pass without the occurrence of a steam vessel upon the coast or ocean being saved from burning or sinking, solely by the use of these pumps, and under circumstances, too, when the ordinary engine and ship's pumps prove totally inadequate to meet the requirements of the case.

If the provisions against fire on board of steam vessels—both as to the means of subduing it, and the proper organization of the officers and crew in the event of fire—were such as to give confidence to the public, there would not, upon its occurrence, exist that want of reliance in the ability to arrest it which is so fatal to the chance of subduing it. When the officers of a vessel are aware of their insufficient means to arrest a fire, and the crew are without that observance of obedience and restraint which is due to discipline and a reliance in their officers, there can be little combination of efforts, and when the inflammable character of a steam vessel is considered, it will be admitted that it is not from the labors of one or a few individuals that success is to be anticipated. It requires a high order of even compulsory discipline for a crew to continue at their posts, with the knowledge that passengers are not only cutting off their means of safety by the occupation of the boats, but terror-stricken and frenzied, they are probably destroying that very means by their confused and ill-directed labors.

So long as the captains of steam vessels do not exhibit to the public that the provisions for personal safety and discipline on board of their vessels is generally adequate to the demand upon them, so long will their labors and that of their officers be rendered impotent, for the crew and passengers, judging of the present by the occurrences of the past, will look for such safety as that which their selfishness will direct, and their own resources will effect for them.

Store Rooms.

Engineers' Store rooms—Should be located away from the fire room or boilers; all inflammable and combustible materials like to turpentine, paints, oil, and tallow, should be kept in metal tanks, securely fastened to the deck, and both they and wiping-stuff, spun-yarn, &c., should be stored in a room other than a tool room or work shop, the location of which should be such that it not only could be readily reached in the event of its being on fire; but it should be so located as to receive sufficient light into it to set aside the use of artificial light, except at night, and then it should be lighted by a fixed light without the room, but shedding its rays into it, alike to the manner in which the magazines on board of vessels of war are lighted.

Lights.—Instead of the universal neglect to give to engine and fire rooms a sufficient light whereby the operations thereof may be conducted without the use of hand lamps; there should be fixed lights of a construction and character suited to give full light to all parts of these rooms; thus setting aside the risk of firing a vessel by the upsetting of a lamp, &c.

IMPROVIDENCE OF CAPTAINS AND ENGINEERS.

Although this is the last cause to which I shall ask your attention, yet it is by no means the least worthy of reference; on the contrary, I consider that if a large majority of these officers better discharged their duties to their employers and to themselves, there would be but little occasion for me to have addressed you this communication.

Captains.—Captains of steam vessels in the superintendence of their construction and equipment, should pay that attention to the requirements of security and provisions against fire, which, if they are at all qualified for the position, their experience and observation will show them to be necessary. The interests of the owners of steam vessels require full attention to these points, their contract with the public, in a moral view, demands it.

Engineers.—As the security against fire on board of a steam vessel are more immediately under the supervision of the engineer than that of any other person, and as he is, or ought to be, better acquainted with the risks therefrom, a strict requirement should be demanded from him, both by the owner and commander of a steam vessel, as to the resort on his part to every practicable security against fire, and every available provision for it if it should occur.

Upon an engineer entering upon duty on board of a steam vessel, it is his first care to advise himself fully as to the security and provisions against fire, and the means to free the vessel from water in the case of her leaking or being bilged, and if she is not properly secured and provided, he should forthwith report this condition of affairs to the captain, and if he or her owner assumes the responsibility of not noticing this report, the engineer has discharged his duty, and he must abide events; if, however, it should happen that human life should be sacrificed by inattention to his report, and the case should come fairly before the public, I am of the opinion that like reports of engineers would receive better attention for the future. If engineers had adopted this course they not only would have effected a just attention to their representations, but they would have saved many lives, both of the public at large and of their own profession.

Unfortunately, however, engineers as a class are the last persons not only to assume this position, but to acknowledge its propriety; for instead of guarding against the dangers which they are best advised of, they appear to consider the exhibition of an indifference to them a point of honor. In corroboration of this, I could present many relations, clearly exhibiting that it is not through the providence of engineers, that the public and the underwriters are to look for safety.

Not only has it required ten years of labor and importunity to introduce the independent steam fire and bilge pump into a bare majority of steam vessels, even with the support and repeated exhibitions of it having saved both vessels and crew, but from the almost united resistance of engineers, it is likely to require a longer period than this to introduce the practice of felting boilers, and protecting the wood work around them.

In fact, the disregard of the owners of steam vessels, and the neglect of the trust confided to the captains as well as engineers, in not directing and requiring the proper precautions against fire is almost universal, notwithstanding vessels and lives without number have been lost in consequence of this neglect, altogether inexcusable and without a justification upon any one point, or under any combination of circumstances.

With them the non-occurrence of a fire where the security is imperfect, is assumed to be conclusive as to the sufficiency of the security from its occurrence at any subsequent period, and if it has so occurred that a boat indifferently secured and provided against fire has run for a period without ever being fired, it would be found very difficult to induce either her owner, captain, or engineer, to adopt any change, having in view any improvement in her security against fire.

As the proportional loss of steam vessels by fire is greater with us than with any other nation, it is not amiss, as a measure of apology for us, that the cause of it should be referred to here, with the view of showing how this blot upon our fame has arisen.

Upon the first introduction of steam navigation in this country it was confined to rivers, bays, and the shores of Long Island Sound, and if a fire occurred, reliance for security of life was had more upon the facility with which the vessel could be run ashore, and the passengers and crew escape thereto, than the probability of subduing it by provisions for the purpose.

Had our first essays occurred at sea, and been restricted thereto like to those of the English, we would have commenced with a better observance of the requirements of security from fire, but unfortunately the burning of a steamer upon a river does not present itself to the feelings of the public, like to a similar occurrence at sea, where, from the losses and horrors that usually attend it, it is universally conceded to be the terror of the ocean.

My purpose in submitting these views to you, as has already been stated, is that of inviting your attention to this subject. If you should see fit to submit this letter to the public, it may be the means of arresting the attention of the owners and officers of steam vessels to the responsibilities of their positions, and should it cause them to reflect upon the nature of their duties both to the public and themselves, I cannot doubt but that some good may be effected thereby; if so, the interests of all and my object will be well accomplished.

American Railway Securities.[*]

It has often been asked why American railway securities and shares, usually excellent, rank so low in market price. The answer is because they have no English agency. Money is much dearer in America than in England. Left to American investors alone, American railways will always, until the flourishing period shall arrive when American money matters will be on a par with English, stand at a lower figure in the market. French and Belgian railway stocks rank nearly equal with English from having London agencies, the absence of which depresses American.

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[*] From Herapath's Journal, Jan. 1857.

Two great and highly successful American railway corporations, the Michigan Central and New York Central (the latter being the London and North Western railway of America), have recently supplied the deficiency, and established agencies in London for the regular transfer of shares and payment of dividends.

In the transfer department a plan has been adopted for the purpose of security, which, in these Robson and Redpath days, deserves attention.

" Messrs. George Peabody & Co., of 22 Old Broad-street, have been appointed the transfer agents of the Company, and the Union Bank of London the registrar of transfers, to countersign the stock certificates, an arrangement intended to guard the stock issues of the Company in a manner believed to be the most satisfactory of any yet practised."

Such is the new plan adopted by one of these large American Companies, which is also a counterpart of that by the other.

It certainly seems calculated to prevent fraud of the character which has so disgracefully blackened the face of 1856 in railway proceedings. With such checks against fraud and forgery, the Robson and Sadleir race must be deprived of their occupation.

For the Journal of the Franklin Institute.

Experiments made at the Steam Flour Mills of Messrs. Hecker & Brother, N. Y. By Chief Engineer, B. F. ISHERWOOD, U. S. Navy.

By the kindness and liberality of Messrs. Hecker & Brother, I have been enabled to make a number of experiments at their Steam Flour Mills, situated at the foot of Bridge Street, in the City of Brooklyn, New York. In the prosecution of these experiments every facility was afforded me, and I received in addition the valuable assistance of late Chief Engineer William Sewell, U. S. Navy. The experiments extended from February 21st, to March 4th, 1855.

The mill contains four run of four feet diameter stones, together with the requisite smut machines, elevators for hoisting and lowering grain, &c., to supply the stones. The stones are used for grinding wheat, and for their normal speed are worked at about 228 revolutions per minute, making six revolutions to each double stroke of the engines pistons. The machinery operating the stones, &c., consists of two high pressure steam engines, fitted with a surface tubular condenser for condensing the exhaust steam and returning it to the boilers in the state of hot distilled water. No air pump is used, but both the steam and cold water sides of the tubes are open to the atmosphere, and consequently no vacuum is formed ; the sole purpose of the condenser being to supply the boilers with fresh water, as owing to the locality sea water only could otherwise be obtained ; the loss from leakage and non-condensation is replenished with rain water. A separate Worthington steam pump is used to supply the condenser with cold condensing sea water, which is pumped up from the bay. The boilers are of the ordinary high pressure kind, cylindrical with return cylindrical flues, and having as an appendage a cross boiler or heater. The dimensions of the entire machinery will be hereinafter given in detail.

The objects of the experiments were principally as follows, viz :—

1. To determine the friction resistance of the engines and main shafting, and to ascertain the law regulating that resistance in function of the speed of the pistons : that is to say, to determine the pressure required to work the engines and shafting alone at any given speed, and to ascertain if any increase of pressure on the pistons is required to work the engines and shafting, *per se*, at different speeds, and if any, what increase.

2. To determine the ratio of the increase of power required to grind wheat at increased speeds, and *vice versa :* that is to say, for example, what increase of power is necessary in order to grind at twice the speed.

3. To determine the potential and economical evaporation by the boilers : that is to say, to determine how much steam the boilers will supply in a given time, and how many units of weight of water are converted into steam per unit of weight of fuel.

4. To determine the efficiency of the condenser : that is to say, to determine what proportion of the steam supplied to it is condensed, and incidentally, the amount of condensing water required, its temperature, and the temperature of the water formed by the condensation of the steam.

5. To determine the general condition and efficiency of the engines with regard to the proportions of their steam passages, their cut-offs, &c., &c., and the most economical manner of using the steam.

The following are the descriptions and dimensions in detail of the different machinery, viz :

Engines.—Two horizontal direct acting engines, working upon the same shaft and at right angles to each other, their motion rendered uniform by a fly-wheel and governor. At each end of the cylinder there is a short D steam slide valve, the two are joined by a rod and worked by an eccentric. The cut-off valve first used was a balanced four-way cock, connected with, and variable by, the governor ; it was also variable momentarily by hand ; it was situated in the steam pipe at some distance from the steam slide valve, and worked with no other friction than what was due to its weight and snug fit. With this cut-off no throttle valve was used. The last cut-off is simply a sliding plate worked by the steam slide valve which draws the plate after it, thereby cutting off the admission of the steam into the cylinder at the very cylinder nozzles. This cut-off is fixed, and closes the steam port when the piston is 0·183 of its stroke from the commencement; a throttle valve controlled by the governor is used with it. The steam pipes leading from the boilers to the cylinders are well covered with felt and canvass, but the cylinders, their valve chests, and connecting pipe, are uncovered.

The following are the principal dimensions, viz:

Diameter of the cylinders,		$15\frac{1}{8}$ inches.
Stroke of pistons,	4 feet.	
Space displacement of *both* pistons per stroke,	9·982 cubic ft.	
Steam space between the first or variable cut-off, and the steam slide valve for both cylinders,	1·953 "	
Steam space between the steam slide valve and the piston, at *one* end of *both* cylinders,	0·049 "	
Area of the steam port, 1 1-16-inch broad by $6\frac{1}{2}$ ins. long,		6·906 sq. in.
" exhaust port, $1\frac{3}{8}$-inch " "		10·562 "
" steam pipe,		8·950 "

Gearing and Shafting.—The engines are connected at right angles to each other on a horizontal shaft 10 inches in diameter. This shaft carries the fly-wheel, and a toothed spur-wheel, 4 feet in diameter, to the pitch line, and 10 inches face—the teeth are 60 in number, and $1\frac{1}{2}$-inch deep. This wheel gears into another of the same dimensions, working another horizontal shaft of 10 inches diameter, at the end of which a bevel wheel of 5 feet pitch line diameter, gears into another bevel wheel of the same dimensions, which operates a vertical shaft from which the power is taken for the work. The aggregate length of the horizontal shafting is 15 feet. The vertical shaft is 60 feet in length and 10 inches diameter at bottom, tapering to 3 inches diameter at top; it is steadied by six journals. The above gearing and shafting comprise what was revolved when the engines operated without load.

Condenser.—The condenser consists of a rectangular box open at the top, and containing a quantity of $\frac{1}{16}$th inch thick copper pipe, disposed horizontally in the shape of "*gridirons;*" that is to say, a number of parallel pipes of equal length lying in the same plane, and connected at each end by a cross-pipe. Each gridiron is composed of 20 tubes of $1\frac{3}{4}$-inch outside diameter, and 58 inches length, disposed parallel to each other in the same horizontal plane, and having a space of $1\frac{3}{4}$-inch wide between them; these tubes are connected at each end by a cross pipe of $7\frac{3}{8}$-inches outside diameter, and 72 inches length; two cross pipes to each gridiron. These gridirons are five in number, they are disposed in the same vertical planes, and are connected at alternate ends by a short vertical pipe in the centre of the horizontal cross pipes.

The exhaust steam from the engines is admitted through a pipe of $7\frac{3}{8}$-inches outside diameter, into the centre of one of the cross pipes of the top gridiron, whence it traverses the succeeding descending gridirons from right to left, and from left to right, alternately, until it arrives at the extreme cross pipe of the lowest gridiron in the state of hot water, which then flows through a small pipe into an outside reservoir open to the atmosphere, whence by a pump connected with the engines, it is continuously drawn off and fed back to the boiler.

The cold sea water for condensing is pumped up from the Bay by a No. 3 Worthington steam pump, and is delivered through a pipe at the bottom of the condenser, whence it rises and runs back to the Bay through an overflow of 8 inches diameter at the top of the condenser; the overflow orifice being above the level of the water in the Bay. The loss by leakage and non-condensation is replenished with rain water. There is no air-pump, and owing to the fact that both the cold condensing water and the hot water of condensation are open to the atmosphere, the pressure on both sides the tubes will be equal, although *all* the exhausted steam were condensed. For the same reasons, the pressure within the tubes, even with a perfect condensation of the exhaust steam, could never be less than that of the atmosphere.

The diameter of the Worthington steam pump is 7 inches, stroke of piston 7 inches. Diameter of the steam cylinder working the pump 12 inches, stroke of piston 7 inches. The following are the dimensions of the condenser, viz:

Length inside of case,		7 feet.
Breadth "		7 "
Height "		4 " 8 inches.
Cubic contents of inside of case,		228·67 cubic ft.
Number of copper pipes $1\frac{3}{4}$-inch outside diameter, and 58 inches length,	100.	
Number of copper pipes $7\frac{3}{8}$-inch outside diameter, and 72 inches length,	10.	
Number of copper pipes $7\frac{3}{8}$-inch outside diameter, and 2 inches length,	4.	
Area of condensing surface in all the above pipes,		303·7 sq. ft.

Boilers.—There are three cylindrical boilers, 44 inches outside diameter, and 30 feet length, placed side by side, set and embedded in brick work in the usual manner. Each boiler contains two return cylindrical flues of 12 inches internal diameter, and 30 feet length. On the top of each boiler is a cylindrical steam drum of 30 inches internal diameter, and 63 inches height; the steam drums are connected at the top by a cross pipe which continues to the engines, and supplies them with steam. The drums and steam pipe are well covered with felt and canvass. The boilers are completely surrounded and covered with brick masonry, so as effectually to prevent the radiation of heat. There is but one furnace, and it is situated below and at one end of the boilers, the fire grates extending clear across without interruption. The grate bars are $\frac{3}{4}$-inch wide on top, with air spaces of $\frac{1}{4}$-inch wide between them; in cross-section, the bars bevel towards the bottom, where they are only $\frac{1}{8}$-inch wide, with air space $\frac{7}{8}$-inch wide between them. Beneath the three boilers, and lying in a direction at right angles to them, is a cylindrical cross boiler or heater of 36 inches external diameter, and 12 feet 2 inches length; this cross boiler having its top connected with the bottom of each of three boilers by a short pipe, is placed in the current of heated gases flowing from the furnace to the chimney, so as to cause the gases to impinge against and be deflected around it. The feed water is pumped into the cross boiler—which is always full of water—and finds its way into the three upper boilers through the connecting pipes. There are four brick bridge walls, similar to each other, in the length of the boilers; they are curved on the top concentrically with the bottoms of each boiler, having a space of $4\frac{1}{2}$ inches left for the passage of the heated gases between the tops of the walls and the bottoms of the boilers.

The following are the principal data of the boilers, viz:

Area of the shells of the three boilers exposed to the heated gases,		510·11 sq. ft.
" cylindrical return flues of the three boilers,		565·49 "
" shell of the cross boiler exposed to the heated gases,		93·06 "
Total area of heating surface,		1168·66 sq. ft.
" " grate "		57·50 "
Cross area between top of bridges, walls, and bottoms of boilers,		6·415 "
" of the cylindrical flues of the three boilers,		4·712 "
Distance traversed by the heated gases from the centre of the furnace to their exit from the flues,		68 feet.
Height of the smoke chimney above the boiler grates,		90 "
Steam space in the shells of the three boilers,		365 cubic "
" " drums " "		77 " "
Total steam space,		442 cubic feet.
Ratio of grate to heating surface,	1·000 to 20·325.	
" cross area between bridges, walls, and boilers to grate surface,	1·000 to 8·963.	
" cross area of the cylindrical return flues,	1·000 to 12·203.	
Aggregate area of air spaces between the grate bars,		13·52 sq. ft.

Determination of the Friction Resistance of the Engines and of the Main Shafting, per se, and of the Law regulating that resistance in function of the speed of the engines' pistons.—Before commencing the experiments hereinafter described, the power required to overcome the friction the engines and of the main shafting, *per se*, was determined by a grea number of trials at different speeds of the engines' pistons. For thi purpose indicator diagrams were taken from each engine; each diagram was traced thrice by the pencil, and where there was any deviation that diagram was rejected. The results thus obtained were found to very closely correspond, the *pressure* being sensibly the same at *all* velocities of piston, showing that the *power* required to overcome the friction resistance of the engines and shafting, was in the direct ratio of the speed of the piston; for the *power* is the product of the *pressure* and the *speed.* During these trials the speed of piston was varied by the throttle-valve from 17 to 44 double strokes per minute, or from 136 to 352 feet per minute. Although the *pressure* on the piston continued always the same to overcome the friction resistance, be the speed of piston what it might, yet for increased speeds it was necessary to open the throttle-valve wider in order to supply the greater quantity of steam required in the same time; so that in order to obtain greater and greater speeds of piston, the throttle-valve needed to be more and more opened, but the pressure remained sensibly the same in all cases, only the opening for the admission of the steam was increased with the increased speed of piston, in order to supply the increased quantity of steam required for maintaining the *same* pressure at the increased velocity of piston. These experiments were varied by entirely shutting off the steam from one engine, and overcoming the friction resistances of both engines and the shafting with the other; in this case, the pressure just doubled what it was with both engines functioning.

The above results are confirmative of the well established law of friction, viz: that it is independent of speed, and that the quantity is measured solely by the space through which it moves; the same friction moving through a double space requiring a double power, be the velocity of its motion what it may. The resistance of the atmosphere to the moving parts of a steam engine, doubtless makes the power required to work it, *per se*, to increase in a ratio slightly greater than direct; but the atmospheric resistance is so slight, and the opposed surface of the moving parts of the engine so small, that the effect is practically inappreciable. The following table contains a selection of the results from a considerable number of diagrams; they will enable the reader to perceive the limits of variation, the widest of which are therein included. Indicator diagram No. 1, is a representative diagram taken with both engines, functioning and overcoming only their friction and the friction of the main shafting. No. 2 is a representative diagram, taken with one engine only functioning, the steam from the other being entirely shut off, overcoming the same friction resistance as in No. 1.

Table containing the results of trials made to determine the Friction Resistance of the two Engines and Main Shafting.

Number of double strokes of engines' pistons made per minute.	Mean effective pressure throughout stroke, in lbs. per sq. in. of pistons.	Mean back pressure above the atmosphere throughout the stroke, in pounds per square inch of pistons.
17	3·94	1·00
17	3·70	1·00
18	3·75	1·00
19	3·75	1·00
19	3·70	1·00
22	3·80	1·12
22	3·94	1·13
38	3·90	1·50
38	3·75	1·50
38	3·95	1·50
38	3·90	1·50
44	3·75	1·75
44	3·70	1·75
44	3·95	1·75
Means,	3·82	1·32

From the above table it will be perceived, that the variations due to imperfections of instrument and observation, were comprised within very narrow limits, the minimum being 3·70, and the maximum 3·94, a difference of 3·14 per centum from the mean 3·82. It will also be observed, that the "back pressure" increased with the increased speeds of piston, which is what should have been the case, there being more steam to be exhausted through the same opening in equal times in the direct ratio of the speed of piston.

Determination of the power required to grind Wheat in Function of Speed.—Experiments were made to determine the relative economy of *power* in grinding wheat at a lesser or greater speed; that is to say, to determine the ratio of the power employed when the mill stones were rotated at different speeds, the same feed being kept on. For this purpose the machinery was worked at full speeds, at two-thirds speed, and at half speed, and indicator diagrams were taken at 30 minutes interval; the diagrams were in all cases traced thrice by the pencil, and those showing any disagreement were rejected. The following table contains the data and results, viz:

Table containing the Results of Trials made to determine the Relative Economy of Power in Grinding Wheat at Different Speeds.

Series.	Pressure in pounds per square inch above the atmosphere.					Steam cut-off at in cylinder from commencement of stroke of pistons.	Actual coefficient of expansion of the steam.	Number of double strokes of engines' pistons made per minute.	Available horses power developed by the engines after deducting 3·82 pounds per sq. inch of pistons for friction of engines and shafting.	Cubic feet of steam of atmospheric pressure used per minute calculated from the pressure at the end of the stroke.	Ratio of pres. on opposing sides of piston.			Number of bus. of wheat cleaned and ground into flour per hour.
	Mean effective pressure on pistons throughout the stroke.	Mean back pressure on the pistons throughout the stroke	Steam pressure in boilers.	Initial steam pressure in cylinders before cutting off.	Steam pressure in cylinders at the end of the stroke above the atmosphere.						Total av'g pres. throughout the stroke includ'g atmosphere in lbs. p.sq.in. pist'n.	Total av. back pres. throughout the stroke inc'g atmosphere in lbs. p.sq.in. pist'n.	Ratio of total back pressure to total average pressure.	
A														
	22·00	2·63	95	38·25	11·25	0·26		36						
	18·00	2·80	From 95 to 100	36·00	9·75	0·23								
	17·63	2·30		38·63	7·50	0·20								
	16·88	2·20		38·63	6·00	0·16								
	17·48	2·70		36·00	7·00	0·22								
	20·63	2·77		34·50	10·50	0·28								
	18·98	2·70	98	33·40	9·75	0·26								
	19·43	2·80	98	33·75	9·70	0·30								
Means	18·88	2·61	97	36·14	8·93	0·239	0·712	36	47·23	1116·2	36·19	17·31	0·478	27
B														
	11·78	1·75	Steam throttled off.	27·00	3·00	0·25		18						
	11·04	1·50		24·25	3·00	0·25								
	11·10	1·50		24·00	4·50	0·25								
	11·37	2·00		23·40	4·50	0·25								
	11·25	1·50		23·63	3·00	0·25								
Means	11·31	1·65		24·46	3·60	0·25	0·707	18	11·75	441·3	27·66	16·35	0·591	13½
C														
	51·00	4·58	83	75·00	30·00	0·37		39						
	48·83	4·84		75·00	27·00	0·33								
	51·97	5·31		75·00	33·00	0·36								
	50·03	5·14		75·00	30·00	0·34								
	49·16	5·25		72·75	29·30	0·35								
	50·25	4·75		75·75	30·00	0·34								
	51·94	5·13		75·00	31·50	0·34								
	52·27	5·03		75·00	32·25	0·35								
Means	50·68	5·00	83	74·81	30·68	0·348	0·786	39	159·21	2196·9	70·38	19·70	0·280	78
D														
	33·07	2·16	96	73·50	16·50	0·13		26½						
	37·42	2·63	97	75·75	19·50	0·15								
	36·90	2·51	96	75·00	18·00	0·15								
	34·86	2·45	96	75·00	18·00	0·15								
	35·85	2·37	94	75·75	17·60	0·16								
	36·75	2·82	89	74·00	18·75	0·18								
	34·88	2·95	84	68·00	16·50	0·18								
	34·73	3·10	84	69·00	17·25	0·18								
Means	35·56	2·62	92	73·25	17·76	0·16	0·601	26½	73·27	1098·9	52·88	17·32	0·328	53

In the above table, comparing series A and B, which were taken with the same mill stones and feed on, the speed being in series B one-half of what it was in series A, and the quantity of wheat cleaned and ground one-half; we perceive that after deducting 3·82 pounds per square inch of pistons for the friction resistance of engines and shafting, the average pressures on the pistons per square inch were (18·88—3·82=) 15·06, and (11·31—3·82=) 7·49 pounds, or sensibly in the ratio of 2 to 1; that is to say, to make twice the number of double strokes of pistons in equal times, twice the pressure was required on the pistons. But the speed at which these pressures moved compared as 2 to 1, and with the double speed, twice the quantity of wheat was cleaned and ground; consequently, the powers 47·23 and 11·75 horses, which are the products of the pressures and speeds, compare as 4 to 1; that is to say, to grind in equal times twice the quantity of wheat by grinding it at double velocity, requires four times the power.

Again, in comparing series C and D, during which exactly the same condition of things existed, with the exception of the speed, which compared as ($\frac{39}{26 \cdot 5}$=) 1·4717 to 1·0000; we perceive that after deducting 3·82 pounds per square inch of pistons for the friction resistance of engines and shafting, the average pressures on the pistons per square inch were (50·68—3·82=) 46·86, and (35·56—3·82=) 31·74 pounds, or in the ratio of 1·4764 to 1·0000, or sensibly in the same ratio as the number of double strokes of pistons in equal times. The quantity of wheat cleaned and ground with series C, was 78 bushels per hour; with series D, 53 bushels per hour, or in the ratio of 1·4717 to 1·0000, being exactly in same ratio as the number of double strokes of pistons made per minute. The power with series C was 159·21 horses, with series D, 73·27 horses, or in the ratio of 2·173 to 1·000. But the quantities of wheat cleaned and ground compared as 1·4717 to 1·0000, and the squares of 1·4717 and 1·0000 are 2·166 and 1·000, or sensibly in the ratio of the powers 2·173 and 1·000. Hence, we perceive, that the amount of wheat ground, is in the direct ratio of the number of double strokes of pistons, but that the power required to grind is in the ratio of the squares of the number of double strokes of pistons in equal times, and that the pressure required to develop this power, is in the direct ratio of the number of double strokes of pistons in equal times.

The indicator diagrams in series A, B, C, and D, were taken at half-hour intervals. The quantity of wheat cleaned and ground was accurately measured. From 36 to 39 double strokes of engines' pistons was the usual speed of grinding.

With series A, and a speed of 36 double strokes of pistons per minute, there was required for cleaning and grinding 27 bushels of wheat per hour, 47·23 horses power, or ($\frac{47 \cdot 23}{27}$=) 1·749 horse power per bushel. With series C, and a speed of 39 double strokes of pistons per minute, there was required for cleaning and grinding 78 bushels of wheat per hour, 159·21 horses power, or ($\frac{159 \cdot 21}{78}$=) 2·041 horses power per bushel. The squares of the speeds 36 and 39, compare as 1·000 and 1·173; the powers 1·749 and 2·041 compare as 1·000 and 1·167, or sensibly the same. It is obvious from the foregoing, that a judicious economy requires a low speed of grinding, and that it is far more economical to employ a greater number of stones to do the required amount of grinding at low speed, than a lesser number at high speed. When grinding at from 36 to 39 double strokes of engines' pistons per minute, corresponding to 216 and 234 revolutions per minute of the four feet diameter mill stones, the flour comes from the stones so hot as to require cooling before it can be packed into barrels. This is opposed to the usual practice of English millers, who obtain the flour from the stones so cold that it can at once be run into the barrels; of course, they grind at a much lower speed. Mr. Ellwood Morris (vide *Journal of the Franklin Institute*, vol. iv. 3d Series, p. 22), ascertained by direct experiment on three excellent overshot flouring mill wheels, having all the modern improvements, that calculating from their whole head and fall while they turned at their usual velocity, everything being in perfect order, they required 788 cubic feet of water, falling one foot per minute, to grind and dress one bushel of wheat per hour. This is an expenditure of power equal to $(788\times 62\frac{1}{2}=)$ 49250 pounds, moving at the rate of one foot per minute, or to $(\frac{49250}{33000}=)$ 1·493 horse power per bushel of wheat per hour.

Determination of the general condition and efficiency of the Engines with regard to the proportions of their Steam Passages, their Cuts-off, &c., and of the most economical manner of using the Steam.—The experiments made for the purposes of determining the ratio of the power required to grind wheat at different speeds—the evaporation by the boilers; the consumption of steam with the two cuts-off, &c., &c., furnish the means of determining the various points of back pressure, average pressure throughout the stroke, ratio of boiler to cylinder pressure before cutting off, actual co-efficient of expansion of the steam, economy of fuel, &c., corresponding to different steam pressures, points of cutting off, and speeds of pistons. The data and results of these experiments will be found grouped into series in the following table. The means of series A, B, C, and D, are from the immediately preceding table. Series E, F, and G, are the mean of fifteen indicator diagrams taken at ten minutes intervals; series H, is the mean of 31 diagrams taken at 20 minutes intervals; series I and J, are each the mean of twenty-eight indicator diagrams taken at 15 minutes intervals.

All the series of the table, with the exception of series J, were taken with the first or variable cut-off, cutting off in the steam pipe. Series J was taken with the last or fixed cut-off, cutting off at the cylinder nozzles.

With series A, B, and F, the steam was found to be greatly throttled in the steam pipe at the old throttle-valve, which was unused, but allowed to remain. This throttle was a cock, and when examined was found to give, when wide open, an area for the passage of the steam of but 5 square inches; after passing this contraction, the steam had still to pass the cut-off, and the steam slide valve, before it could enter the cylinder.

Series.	Pressure in pounds per sq. in. above the atmosphere.					Steam cut-off at in cylinder from commencement of stroke of pistons.	Actual coefficient of the expansion of the steam.	Number of double strokes of engines' pistons made per minute.	Available horses power developed by the engines after *deducting* the 3·82 pounds per square inch of pistons for friction of engines and shafting.	Total horses power developed by the engines *including* the 3·82 pounds per square inch of pistons for friction of engines and shafting.	Cubic feet of steam of atmospheric pressure used per minute, calculated from the pressure at the end of the stroke.	Ratio of the pressures on opposing sides of pistons.			Relative economy of fuel.			
															Available horses power.		Total horses power.	
	Mean effective pressure on pistons throughout the stroke, including the 3·82 lbs. per sq. in. for friction of engines and shafting.	Mean back pressure on the pistons throughout the stroke.	Steam pressure in boilers.	Initial steam pres. in cylin's before cut'g-off.	Steam pressure in cylinders at the end of the stroke above the atmosphere.							Total average press. throughout the stroke including atmosphere, in pounds per sq. inch of pistons.	Total average back pressure throughout the stroke, including atmosphere, in pounds per square inch of pistons.	Ratio of total back pres. to total av'ge press.	Cubic feet of steam of atmospheric pressure per available horse power.	Cubic feet of steam of atmospheric pressure per available horse power proportionably.	Cubic feet of steam of atmospheric pressure per total horse power.	Cubic feet of steam of atmospheric pressure per total horse power proportionably.
A	18·88	2·61	97	36·14	8·93	0·239	0·712	36·0	47·23	59 20	1116·2	36·19	17 31	0·478	23·63	2·114	18·86	1·923
B	11·31	1·66		24·46	3·60	0·250	0·707	18·0	11·75	17·74	441·3	27·66	16·35	0 591	37·56	3·359	24 88	2·536
C	50 68	5 00	83	74·81	20·68	0·348	0 786	39·0	159·21	172·18	2196 9	70·38	19·70	0·280	13·80	1·234	12 76	1·301
D	35·56	2·62	92	73 25	17·76	0·140	0·601	26·5	73·27	82·09	1098·9	52·88	17·32	0·328	15·00	1·342	13·39	1 365
E	44·32	4·36	83	72·23	23·63	0·298	0·729	38·0	134·07	146·71	1808·6	63·38	19·06	0·301	13·49	1·207	12·33	1·257
F	28·17	2·78	87	40·50	16·02	0·412	0·827	35·0	74 24	85 89	1381·1	45·65	17·48	0·383	18·60	1·664	16·08	1·639
G	35·40	3·54	80	67·40	15·91	0·237	0·654	38·0	104·54	117·19	1494 6	53·64	18·24	0·340	14·30	1·279	12·76	1·301
H	32·80	3·57	81	66·00	15·80	0 203	0·634	37·0	93·41	105·72	1450·5	51·07	18·27	0 358	15·53	1·389	13·72	1·398
I	31·22	3·22	91	72·00	13·30	0·152	0·566	38·6	92·14	104·98	1399·0	49·14	17·92	0·365	15·18	1·358	13·33	1·358
J	31·22	2·08	80	76·20	5·36	0·183	0·628	38·6	92·14	104·98	1030·4	48·00	16·78	0·350	11·18	1·000	9 81	1·000

In series A, the cock-throttle being wide open, the steam pressure in the cylinder before cutting off was only 37·26 per centum of the boiler pressure, comparing the pressures above the atmosphere, the cut-off closing at 0·239 of the stroke of pistons from the commencement. The cut-off was then changed to close at 0·412 of the stroke from the commencement, when the cylinder pressure became 46·50 per centum of the boiler pressure, and could not be made higher even when cutting off longer. As soon as this effect of the throttle was discovered, it was removed entirely, leaving the area of the steam pipe at that point 8·95 square inches. Series E was then taken, the cut-off closing at 0·298 of the stroke from the commencement; the cylinder pressure now rose to 87 per centum of the boiler pressure.

It is necessary to here explain that the first cut-off valve could be adjusted at will, making it close sooner or later by giving its axis less or more vibration; but just in proportion as the vibration was lessened, was the opening for the passage of the steam decreased, so that the cut-off valve had the double functions of an expansion valve and a throttle valve—the shorter it cut off the more it also throttled. It was a necessity of its construction also, that the tapering cylindrical plug should be an easy fit in its chamber, and it was adjusted by screws that had to be regulated continually for the unequal expansions of the plug and its chamber; there resulted from this, that the valve leaked unequally in a small degree, sometimes leaking more steam than at others, which is perceptible on comparing the actual co-efficients of the expansion of the steam as given in the above table, with the points of cutting off. The comparative ratio of throttling by the cut-off valve when adjusted at different points of cutting off, appears in the following table, viz:—

Series.	Point of cutting off from the commencement of the stroke.	Ratio of the cylinder to the boiler pressure.	Series.	Point of cutting off from the commencement of the stroke.	Ratio of the cylinder to the boiler pressure.
I	0·152	0·79	G	0·237	0·84
D	0·160	0·80	E	0·298	0·87
H	0·203	0·82	C	0·348	0·90

Finally, it was determined to remove the variable cut-off valve, and replace it with a fixed cut-off valve, cutting off the steam at the cylinder nozzles. For this purpose a movable frame was placed in the valve chest around the steam slide valve, but with a certain amount of play between the ends of the steam valve and the frame. By this arrangement the steam valve was free to move alone a short distance, when it struck the frame and drew it after it, the frame closing over the steam port and cutting off the steam. The same eccentric worked both steam and cut-off valve; in fact, the arrangement amounted to working the cut-off by a tappet on the stem of the steam valve with the advantage that the steam was cut off exactly at the cylinder nozzles. The width of the frame pieces at the ends of the frame amounted to so much lap placed on the steam valve, which acted to cut off the steam very short without the disadvantage of disarranging the exhaust. The addition of this frame did not require the eccentric of the steam valve to be changed. The side pieces of the frame were, of course, only useful to connect the end pieces of the frame. With this cut-off, the first one having been entirely removed, series J was taken, when the cylinder pressure rose to 95 per centum of the boiler pressure, showing that a proportion of 1 square inch of opening to every 1249 cubic inches of space displacement of piston per stroke, was sufficient for the admission of steam, having 95 per centum of the boiler pressure with a velocity of piston of 308·8 feet per minute. The steam pipe was 30 feet long, with three right-angled bends.

The reason for changing the cut-off valve, was to avoid the loss of the expansion of the steam between the first cut-off valve and the steam slide valve. This loss, from the great capacity of that space which was equal to the area of the cylinder by a length of 0·783 foot, was very considerable. The result of the change was extremely satisfactory, as will appear from a comparison of series I and J, taken to practically determine the point. In both series, the mean effective pressure throughout the stroke of piston, number of strokes of piston made per minute, and horses power developed by the engines, were made precisely the same; the ratio of the back pressure to the average pressure for the stroke was also nearly the same, but with series I (first cut-off), the steam was cut off at 0·152 of the stroke of piston from the commencement, while with series J (last cut-off), the point of cutting off was fixed at 0·183 of the stroke; but notwithstanding this disadvantage, the gain in steam, and consequently in fuel, amounted to 35·8 per centum—that is to say, if the fuel required with the last cut-off be taken at 1000 for a given power, then to obtain the same power with the first cut-off, would require of fuel 1358. After these experiments the last cut-off was permanently retained, giving steadily the above gain of fuel. With the last cut-off a gain was also effected in the back pressure, the final pressure in the cylinder at the end of the stroke being considerably reduced (in series I and J, from 13·50 to 5·36 pounds per square inch above atmosphere), and as a consequence, there was a less quantity of steam to exhaust through the openings, making the back pressure on the pistons above the atmosphere respectively 3·22 and 2·08 pounds per square inch, while the average pressure throughout the stroke remained the same.

(To be Continued.)

Extracts from the Engineer's Report to the Trustees of the Philadelphia Gas Works, for the year 1856.

The several factories belonging to the Trust, have produced in the year 1856, four hundred and thirty-four million seven hundred and forty-two thousand cubic feet of gas: of which 163,930,000 cubic feet were made at the works in First Ward; 184,357,000 in Ninth Ward, and 86,455,000 in Fifteenth Ward.

The largest quantity used in twenty-four hours, was 2,166,000 cubic feet, on the last night of the year, and the largest daily product of the several works has been 799,000 in First Ward; 1,084,000 in Ninth Ward, and 440,000 in Fifteenth Ward.

These maximum daily productions did not occur simultaneously, and therefore their aggregate amount was not produced on any one day, it having been found most convenient to manage the different factories in such way, that one might be in full working, when the yield of another had fallen off by reason of the wear of its retorts.

The largest daily average yield of each retort in the year was

7194 feet at the works in First Ward.
5382 " " Ninth Ward.
5150 " " Fifteenth Ward.

The largest quantity from each pound of coal respectively, made for any full day's work.

$4\frac{92}{100}$ feet at the works in First Ward.
$4\frac{65}{100}$ " " Ninth Ward.
$4\frac{64}{100}$ " " Fifteenth Ward.

At the several manufacturing stations no new constructions have been undertaken in the past year; the improvements completed being only those that had been previously commenced.

Of these, the most important is the large gas-holder, No. 12, which was so far completed in the autumn as to be in good working condition. It was put in operation early in the winter, and has continued to work with great steadiness and regularity.

Its efficiency as a great reservoir and regulator of pressure, during the hours of maximum consumption, has fully equalled every expectation. Its advantages in these respects cannot easily be over-estimated, and by its steady action during several violent gales of wind, it proves that a gas-holder of very large dimensions is much more dependable than those that are smaller.* Notwithstanding the unexpected obstacles encountered in the construction of this gas-holder and tank, by reason of the difficult character of the foundations and casualties of the weather, it is worthy of note, that its cost per cubic foot, of capacity, is much less than that of any other gas-holder ever built at these works, with the exception only of No. 11, which being also of unusually large size, was constructed at less cost per cubic foot than any other, of which I have any knowledge, in the United States.

Had the unlooked-for difficulties alluded to, not occurred, the relative cost of No. 12 would have been below that of No. 11, and it may now be esteemed an established truth, that in all large works economy is promoted by the use of gas-holders of very large dimensions. As it is believed that two gas-holders of as large capacity as these, are not to be found at any other Gas Works, the present may be considered a suitable occasion for a brief description of them.

No. 11 was built in 1850, and has been in almost constant use since that year. It is of telescopic plan, 140 feet in diameter and 70 feet high, containing one million cubic feet.

Gas-holder No. 12 was put in operation early in December last; it is like the other, telescopic in form, 160 feet in diameter and 90 feet high, containing one million eight hundred thousand cubic feet. The tank is 162 feet in clear diameter, and 46 feet deep, excavated in gravel and clay, with a central mound 25 feet high.

When the excavation for this tank had been sunk nearly to the depth required for the foundation and floor, the substratum of stiff clay was forced upward by the pressure of water beneath, revealing a quicksand that existed about 55 feet below the top level of the tank, which had not been detected by borings previously made to a depth of more than

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* Since the presentation of this report to the Trustees, the occurrence of the great snow storm, of January 18th, accompanied by a gale of unusual violence, has afforded another opportunity for testing the stability of this gas-holder. At the time of the storm it was raised more than forty feet high, containing over 800,000 cubic feet of gas, and showed not the slightest symptom of unsteadiness or excessive strain.

50 feet, for the purpose of proving the nature of the ground. This unwelcome discovery made it necessary, for the proper security of the foundations, to adopt some expedient for reaching a firm bed of gravel, which was found to lie about 70 feet from the surface. The great influx of water at this depth, of more than 40 feet below tide, forbade any other mode of reaching this solid bottom than by driving piles. Some thousands were driven in such positions as would allow the tank walls, the guide towers, and the floor, to rest on heavy timbers secured by bolting to the piles after the latter had been driven home in the solid gravel below.

These timbers are laid close together, radiating from the central mound to the outer circumference of the foundation walls; their joints were tightly caulked, and the whole covered with a bed of hydraulic concrete. The tank walls are of rubble masonry, built in two separate rings, the outer one, four feet thick, laid in gravel mortar; the inner one, eighteen inches thick, laid in hydraulic cement, with an interstice of six inches filled in with hydraulic concrete. To increase the tightness of the bottom, it is covered by a dome-shaped pavement of brick, grouted with hydraulic cement. An annular wall of stone is built within the tank, midway between the outer wall and the centre. Upon this are placed 24 tressel frames, 35 feet high, which sustain the crown of the gas-holder, so as to prevent the swag of the sheets when unsupported by the gas. No rafters are used, nor any interior frame work, except a series of tie-rods, which are secured to the crown sheets in such way as to distribute over its entire area the weight of the centre post and the vertical sides.

This arrangement was adopted in consequence of the great weight required to give the holder such pressure as would control all the others connected with the several works, all of which are more than three miles distant, and some two and three times more remote.

To facilitate the future increase of its pressure, the legs on which the inner section stands, and against which the outer section is guided, are made of cast iron, and hollow, for receiving the additional weights that may hereafter be required.

To support and guide the gas-holder, there are twelve towers of cast iron, ninety-five feet high, standing on stone bases; their form is pentagonal, about twelve feet in diameter. The girders connecting the towers are in the form of a heavy balustrade, with open quatrefoil panels, and are placed fifteen feet below the summits of the towers.

The weight of metal in the whole structure is over one thousand tons. That of the gas-holder alone about three hundred tons.

To those who are not familiar with the properties of gases, it may appear incredible that a vast structure, weighing over 600,000 pounds, can be sustained with safety, resting solely upon a fluid so light and subtle as illuminating gas, whose density is less than half that of atmospheric air, or only one sixteen-hundredth part the weight of water. But the great diameter of this machine gives it an area of 20,000 square feet, and the whole pressure due to its weight is only 30 pounds on the square foot, equal to a column of water not quite six inches high.

It is therefore raised with the greatest ease by the inflowing gas; by which it can be lifted out of the water of the tank, to a height of ninety feet, and as the gas is consumed or passed into the other holders, it is gently lowered, with the silent, steady motion of a great pneumatic press.

Another structure which has been completed during the past year, is the hydraulic elevator, used for raising coals from the wharf, into the coal stores recently constructed at the First Ward works.

The construction and operation of this machine are of extreme simplicity. Two rectangular water-tight boxes, made of boiler iron, capable of holding about 1½ tons of water, each, are suspended to the ends of a strong chain that passes over a wheel placed at the top of the hoisting tower. The length of the chain is such, that one box is level with the railroad track on the wharf, when the other is level with a similar track leading into the attic of the coal stores; a short section of rail track on top of each box is adjusted to fit these main tracks when the boxes are in place.

A loaded car being run on to the lower box, and a light car on the upper one, water is allowed to flow into the latter, from a cistern, until its weight preponderates, when it descends and raises the loaded car, its velocity being regulated by means of a powerful friction brake, which is worked by an attendant, who likewise works the valves for supplying the water.

When the descending car reaches the bottom of the tower, a self-acting valve opens and allows its load of water to escape.

After the coals have been delivered from the vessel at the wharf, into an iron car, placed on a railway laid along the water's edge, they need no further handling, being drawn by a mule to the platform of the elevator, by which they are hoisted 60 feet, to a track leading into the attic of the coal stores, when they are dropped from the car, at a height which allows the pile to trim itself to the slope of the roof; thus filling up the store more completely than could be done by any other mode, and saving more than three-fourths the expense of storing in the usual way. As the two coal stores now erected are capable of holding only about one-half the coal required for the winter's supply, it will be a measure of good economy to build two more in the present year; whereby the saving of expense in handling and hauling may be gained upon the whole quantity used, and the coals may be more perfectly protected from damage, than they can be in temporary sheds.

In constructing the retort benches at the First Ward station, provision was made for their adaptation to various different plans of setting the retorts in the fire arches, without disturbing the permanent masonry. The superior facilities for making comparative trials of different plans thus secured, have not been without their proper fruits.

The Assistant Engineer, under whose immediate direction the works at this station are placed, has introduced a new plan of setting in an open arch, disencumbered of the usual complex arrangement of flues, from which he has produced results much more economical than any heretofore obtained at the older works. The daily yield when the beds are new and in good condition, has been over 8000 cubic feet of gas from each retort, or about 25,000 from a bed of three. The aver age yield, during the operations of an entire season, has been nearly 7000 feet a day from each retort, or 20,000 feet from the bed of three.

The contrast of results derivable from different modes of setting the retorts, is exhibited very clearly in a trial made at the request of a Trustee, of another plan of setting, used in a neighboring City. In order to ensure the utmost fairness and accuracy of the comparison, the retorts used were of the same pattern, exactly alike in all respects. The beds in which they were placed, were immediately contiguous in the same section of retort bench, and were worked by the same gang of stokers, using the same kinds of coal and fuel. The trial was continued many months, and until the retorts were used up, so far as practical economy of use would permit. The contrast is remarkable and instructive. When the new setting was first put at work, with the flue dampers adjusted according to instructions given by its suggestor, the daily yield was about 3700 feet to the retort, or 11,000 to the bed of three retorts. By a different adjustment, found upon experiment to produce the best results obtainable, the yield was increased to 4300 feet per day from each retort, or about 13,000 feet from each bed of three. This was the utmost they could be made to yield, without endangering the destruction of the bed by melting down the furnace.

As these results speak for themselves, they require but brief comment. The cost for retorts, for retort-house room, and for labor of working, is the same in both the plans of setting; the daily product in one case exceeds that in the other by one-half.

The setting in open arches, when fully introduced, will much increase the capacity and profitable results of our works; the other would take largely from us in both these respects. The practical difference between the adoption of the one or the other, in its money value, on our present scale of operations, would amount annually to the interest on a capital of more than half a million of dollars.

Another year's trial of the cellular retort, for the production of gas from vegetable substances, has confirmed the results heretofore reported, with respect to the quantity and illuminating quality of the gas thus obtained. As there seemed to be some doubt as to the permanency of this gas, it was thought worth while to test it in such way as would bring the question to a satisfactory solution.

A considerable quantity of it (30,000 cubic feet) was stored in a gas holder by itself, and after remaining thus isolated several weeks, was tested photometrically. It had not changed perceptibly, having retained its illuminating power as completely as coal gas under similar trial.

With the present relative prices of wood and coal in the Philadelphia market, the cost of making gas from the former is somewhat the lower, but the difference is not sufficient to justify the immediate abandonment of the latter. Should a commercial change occur, by which the price of coals should be again advanced to the high point reached two or three years ago, there might arise important advantages to these works and its customers, from the ability to make the substitution of wood for coal.

It will therefore be consistent with good policy to continue, as heretofore, the use of such number of wood retorts, as can be supplied with that material, without sensibly affecting its market price, particularly as their use is accompanied by some immediate profit and entails no extra cost for the contingent advantages it presents.

A very careful and accurate analysis and photometric examination of wood gas have been made by two eminent analytical chemists (Dr. Wolcott Gibbs, of New York, and Dr. F. A. Genth, of Philadelphia), whose report of their chemical results furnishes a highly satisfactory explanation of certain curious phenomena that accompany the combustion of this gas.

They examined two varieties of gas, one made from old field pine, the other from small second growth oak, with the following results:

	Gas from Pine.	Gas from Oak.
Specific gravity,	0·663	0·580
Composition.		
Hydrogen,	32·71	30·44
Light Carb. Hydrogen,	21·50	33·12
Olef. Gas and Hydro Carbon Vapors,	10·57	6·46
Carbonic Oxide,	27·11	26·11
Carbonic Acid,	4·90	0·48
Oxygen,	0·66	None.
Nitrogen,	2·55	3·39
	100·00	100·00

These gases were collected at the Ninth Ward works, and taken to New York for analysis. Their illuminating power was tested and found to be over 26 candles for a five feet burner.

A subsequent series of photometric trials of wood gas, previously passed through a long pipe exposed to a temperature of 15° F., gave an average of 18·3 candles from a burner consuming 4·6 feet per hour.

The conclusion at which these gentlemen arrive from their elaborate examination is, "that wood gas, in illuminating power, is fully equal to the average of coal gas."

The growing magnitude of the operations, at the different offices and works managed under the gas trust, and their constant mutual dependence, have created a necessity for frequent intercommunication of intelligence, and official directions, such as can be most perfectly obtained, only by means of the magnetic telegraph. No time, therefore, has been lost in carrying into effect the recent directions of the Board upon this subject; and the contractor is moving so promptly, that the line will very soon be in readiness for use.

Of the advantages to be derived from this, it is not easy to form in advance anything like an adequate estimate. In the management and control of the numerous gas-holders, many miles apart, but in close mechanical connexion, it will add greatly to their security. In the regulation of the street main pressure, at various points during the hours of lighting, it will prevent the inconveniences that now so frequently result from the want of prompt information at the Works. In regulating the lighting and extinguishing of the public lamps, in giving a knowledge of the exact locality of fires, and in a vast number of other matters, it will be truly of inestimable value.

For the Journal of the Franklin Institute.

Practical Remarks on the Saturation of Marine Boilers. By JAMES H. WARNER, Eng. Corps, U. S. N.

The evaporation of water and formation of steam in the boiler of a steam engine, is analogous to the ordinary process of distillation. The principal object of such process, being to separate and collect the more volatile of any two fluids that may be mixed together, and the operation is founded upon the difference in the boiling points of such fluids. If water be evaporated, and the vapor condensed in a separate vessel, the distilled water will be perfectly pure, as the non-volatile, earthy or saline matter does not pass off with the vapor; and if it were possible to supply steam boilers with pure water, there would of course be no sediment or deposit; but such is seldom and perhaps never the case, as all water available for such purpose, contains more or less of vegetable, earthy, or saline matter.

Ocean and other steamers plying in salt water, necessarily use it for the generation of steam, and steam from salt water being fresh, the saline matter remains within the boiler, as in the process of distillation.

Sea water from various localities, has been found to contain slightly varied proportions of salt and other substances, and the average is generally assumed to be 3 parts in 100 parts of water, or about 1 pound of such matter in 33 pounds of water; and when referring to the density of sea water, we say it is $\frac{1}{33}$, or more frequently $\frac{1}{32}$. According to an approved analysis, 10,000 parts of sea water contains:—

Chloride of sodium,	220·01	$= \frac{1}{46}$
Sulphate of soda,	33·16	$= \frac{1}{302}$
Muriate of magnesia,	42·08	$= \frac{1}{238}$
Sulphate of lime,	7·84	$= \frac{1}{1276}$

This analysis affords the practical engineer no indication as to the nature of the deposit upon the interior surfaces of a boiler, technically known as "scale." Of the above constituents, chloride of sodium, or muriate of soda, is a salt of an alkali-metal, consisting of chlorine and sodium, or muriatic acid saturated with soda, and is simply common salt. Sulphate of soda is found in various mineral waters, although it is readily prepared from common salt, and was formerly used as a medicine, under the name of *Glauber salts.* Muriate of magnesia, is a salt of an alkaline earth, and is readily converted into sulphate of magnesia or *Epsom salts*, a well known purgative medicine. It is the presence of this salt that causes the bitter taste of sea water, and it vitiates the quality of the salt made in process of natural evaporation.

Sulphate of lime or *Gypsum*, is of frequent occurrence in nature, in some places forming entire ranges of hills, and is an important staple of commerce. It is occasionally found in spring water, but all natural salt water contains it in solution, and from the fact of its being very sparingly soluble, it is the first of the salts deposited in a marine boiler, constituting the principal ingredient of scale.

Of the different waters, southern seas are reputed to contain more of foreign substances than those of northern latitudes; at least it is supposed that a deposit is made and scale formed sooner and more abundantly in some portions of our southern waters. This may in a great measure, be attributed to the extensive coral formations abounding in such districts, from which the water may derive additional quantities of the salts of lime, inducing precipitation at lower degrees of saturation and temperature. But the Arctic seas really contain a much greater proportion of salt than other waters, consequent upon the immense mountains of ice formed in those regions, and from the fact that ice from salt water is fresh, all impurities being separated in process of freezing or evaporation.

The boiling point of water will be raised in the event of chemical combination with any substance calculated to increase its density, and in a direct ratio with such increase, but foreign matter held only in mechanical suspension, does not affect the boiling point.

The following is an abstract from a table current in approved authorities, indicating the boiling point for different degrees of density, the mean atmospheric pressure being 29·998 inches of mercury:

Kind of Water.	Density.	Boiling point.	Increase of temperature.	Kind of deposit.
Pure fresh water,	0	212°		None.
Common sea water,	$\frac{1}{32}$	212°	1·2°	
	$\frac{2}{32}$	213·2	2·4	
	$\frac{3}{32}$	215·5	3·5	
	$\frac{4}{32}$	216·4	4·4	
	$\frac{5}{32}$	217·9	5·9	Sulphate of lime.
	$\frac{6}{32}$	219·1	7·1	
	$\frac{10}{32}$	223·8	11·8	
Saturated solution,	$\frac{12}{32}$	226·1	14·1	Common salt.

A deposit of sulphate of lime takes place, as we observe, far below the point of saturated solution, and at a comparatively moderate degree of concentration. Observing the actual process of evaporation, this early deposit becomes apparent. Each particle of water, coming in contact with the heated metallic surface, is immediately converted into steam, the pure water passing off in the form of vapor, whilst all foreign matter is separated from it, and will either be dissolved by the surrounding water, or held in suspension, and finally deposited upon the surfaces in contact. Common salt has the remarkable property of being equally soluble in *hot* or *cold* water, and to a degree of concentration that cannot exist in a marine boiler, without absolute destruction. But not so with the salts of lime, they are very sparingly soluble; half an ounce of water will dissolve but half a grain of sulphate of lime; the quantity of water thus required, increasing with the density.

Hence the salt when discharged from each particle of water, is immediately dissolved, whilst only a small portion of the salts of lime are thus taken up; they are, therefore, temporarily held in suspension, whilst they accumulate, and by means of currents, become diffused through the entire mass, and thence deposited upon all the surfaces in contact with the water. The time required to produce this result depends upon the quantity and temperature of the water, incidental to the rate at which evaporation is going on within the boiler. Of boilers having an equal amount of heating surface, that which contains the greatest quantity of water, will be most easily managed in this respect.

Recent experiments made in France, would seem to indicate that with a temperature corresponding to about 100 pounds pressure, sea water ceases to hold any substance in solution. A supplementary apparatus was suggested, based upon this fact, and to be applied for the purpose of separating saline matter from the water previous to entering the boiler. However advantageous such arrangements might be if successful, practical experience has demonstrated that with the maximum pressure and temperature adopted in marine boilers, they can be maintained comparatively free from an injurious accumulation of scale.

The first successful sea steamers were not provided with means to prevent the excessive formation of deposit, and it was of frequent occurrence that the boilers became so clogged as to render it necessary to stop and clean them, even during short passages. This fact was then considered an insurmountable barrier to the successful application of steam to ocean navigation. The mitigation of this difficulty is due to Boulton and Watt, who devised means somewhat similar to that now in use for such purpose, that is, the system of "blowing off," or otherwise extracting constantly or at definite intervals a portion of the supersalted water sufficient to maintain a moderate degree of saltness.

Whilst evaporation is going on it would be impossible to keep the water at its original density, but in accordance with the preceding table, no deposit takes place until it has attained $\frac{5}{32}$, or about five times the natural density, whence the water might be kept at any point of saturation below $\frac{5}{32}$. But this table, which may be correct, is true only with water subjected to atmospheric pressure; the least increase above that pressure and corresponding temperature will hasten precipitation so far as the salts of lime are concerned. However, in practical experience, evaporating various kinds of water, and under different conditions of pressure and temperature, the exact point at which a deposit will be made is rather difficult of determination; it is, therefore, the best policy always to keep within a safe limit, which, under ordinary circumstances, should be under, rather than exceed $\frac{2}{32}$, a point easily maintained with proper care and attention.

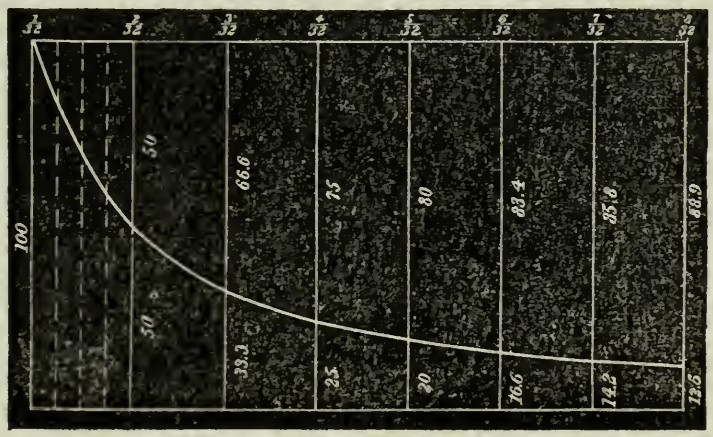
If from a given quantity of sea water of the usual density, or $\frac{1}{32}$, we evaporate one-half, the density of the remaining half will be $\frac{2}{32}$, one-half of the original quantity containing the whole of the saline matter, and if the evaporation is continued until one-fourth remains, it will be $\frac{4}{32}$, and if to one-eighth $\frac{8}{32}$; the respective quantities of water being 1, $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$, and the corresponding densities will be $\frac{1}{32}$, $\frac{2}{32}$, $\frac{4}{32}$, and $\frac{8}{32}$. But in the process of evaporation within a steam boiler, the original quantity of water must be preserved, consequently, we find it necessary to introduce a fresh supply equal to that which is evaporated, and as all the saline matter remains in the boiler, the whole mass will gradually increase in density. The ratio in which this increase takes place may be illustrated by the following method, when we will assume the total quantity of water to be 100, and that we alternately evaporate and feed 50 parts.

	Density.		Total.	Total.	Ratio.
Initial quantity,	100	$\frac{1}{32}$	100		$\frac{100}{50}=2$
Evaporate,	50			50	
Remaining,	50	$\frac{2}{32}$			
Feed,	50	$\frac{1}{32}$	150		
	100	$\frac{1\cdot5}{32}$			$\frac{150}{100}=1\cdot5$
Evaporate,	50			100	
	50	$\frac{3}{32}$			
Feed,	50	$\frac{1}{32}$	200		
	100	$\frac{2}{32}$			$\frac{200}{100}=1\cdot33$
Evaporate,	50			150	
	50	$\frac{4}{32}$			
Feed,	50	$\frac{1}{32}$	250		
	100	$\frac{2\cdot5}{32}$			$\frac{250}{200}=1\cdot25$
Evaporate,	50			200	
	50	$\frac{5}{32}$			
Feed,	50	$\frac{1}{32}$	300		
	100	$\frac{3}{32}$			$\frac{300}{250}=1\cdot20$
Evaporate,	50			250	
	50	$\frac{6}{32}$			
Feed,	50	$\frac{1}{32}$	350		
	100	$\frac{3\cdot5}{32}$			$\frac{350}{300}=1\cdot16$
Evaporate,	50			300	
	50	$\frac{7}{32}$			

Hence, assuming 1 to be the initial quantity of water supplied, the numbers 1, 5, 33, 25, 16, &c., indicate the proportional amount of water that must be "blown off," or otherwise extracted, or, in other words, to keep the water at its natural density, we should have to blow off 1, or the total amount supplied; to keep a density of $\frac{2}{32}$, one-half must be blown off, at $\frac{2}{32}$ one-third, at $\frac{4}{32}$ one-fourth, &c.

The rationale of this process may be further explained: suppose we have the given quantity of water 32 pounds, containing 1 pound of saline matter. If from this we evaporate 16 pounds, we have 16 pounds remaining, which contains the original quantity of salts, and consequently, has a density of $\frac{2}{32}$; then if we add to this 16 pounds at $\frac{1}{32}$, containing $\frac{1}{2}$ pound of salt, we have 32 pounds of water and $1\frac{1}{2}$ pounds of saline matter, the density being $\frac{1.5}{32}$, with an increase of $\frac{1}{2}$—32. Repeating this operation, evaporating 16 pounds, there will remain 16 pounds of water and $1\frac{1}{2}$ pounds of salt, having a density of $\frac{3}{32}$; again supplying 16 pounds at $\frac{1}{32}$, we have 32 pounds of water and 2 of salts, corresponding to $\frac{2}{32}$. The density previous to this operation being $\frac{1.5}{32}$, the actual increase will be $\frac{1}{2}$—32, as before, but the *ratio* of increase will be as $1\frac{1}{2}$ to $\frac{1}{2}$ or $\frac{1}{3}$. If this process be continued, the density would increase successively $\frac{1}{2}$—32, whilst the ratio would be inverse, or as $1\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, &c. Hence, it is evident, that by blowing off a sufficient quantity of the supersalted water to *counteract* this ratio of increase, the density can be maintained within a desired limit. But we might here remark, that although we nominally "blow off" for the purpose of guarding against undue concentration, it is the *feed* that freshens the water in a boiler; we might blow off in vain but for the introduction of feed water which is comparatively fresh. Therefore, we feed an additional quantity, more than is required for evaporation, and *blow off the surplus*.

The following diagram illustrates the law, in connexion with the ratio,



between the amount of water evaporated and that blown off. That portion of the diagram included between the curve and its assymptotes, indicates the quantity blown off.

On the Geology and Physical Geography of North America.[*] By Prof. HENRY D. ROGERS, from the United States.

(Continued from page 230.)

D. THE GREAT WESTERN DESERT PLATEAU.

Between the Rocky Mountains on the east, and the Pacific Alps, Cascade Chain, and Sierra Nevada on the west, there stretches from the Gulf of California to the Arctic Ocean, an elevated desert zone of great breadth and height, especially in its central section, between latitudes

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[*] Notices of the Meetings of the Royal Institution of Great Britain, Feb. 8th, 1856.

35° and 45°, where its mean level above the sea is about 5000 feet. It consists of three principal regions,—the Central Desert Plateau, now indicated; a semi-desert area, south-east and south of this, the basin of the Rio Colorado, divided from it by the Wahsatch Mountains; and a northern region, that of the Columbia and Frazer's Rivers, sterile and rugged, separated from the central by the mountains south of the Columbia.

The Central Plateau, or Great Utah Desert, is an almost rainless region, parched by dry winds. The evaporation balancing the rain-fall, none of its scanty drainage passes to the sea, but each attenuated stream ends in a closed lake, the water of which is more or less salt. It is a vast elevated arid waste, containing wide plains encrusted with salt, a soil generally more or less saline, and large tracts of light volcanic scoriæ and ashes. Through its centre there runs, southward, a broad belt of straight mountain ridges, the Humboldt Mountains, composed in part of crystalline rocks, in part of carboniferous limestone, and other palæozoic strata. The chief stream is the Humboldt River, which, flowing west, dies away in the salt plain before it reaches the foot of the Sierra Nevada. There are twelve or fifteen salt lakes of considerable magnitude in this high insulated basin. The largest of these is the Great Mormon, or Utah Salt Lake, the waters of which are impregnated almost to saturation, containing 20 per cent. of common salt, and 2 per cent. only of other salts. Its length is seventy-five miles, and mean breadth about 30 miles.

The Southern Desert Basin, or that of the Rio Colorado, lying between the Rocky Mountains and the Wahsatch and Californian Mountains, is, like the Utah Desert, a succession of arid table lands and plains, intersected by rugged mountains. Its north-eastern portion is better fed with rain than its western; those tracts most under the lee of the intercepting barrier of the Pacific Mountains being more desiccated than the districts further removed. The Pacific Mountains are also less elevated in this latitude than further north, opposite the Central Desert. This Southern or Colorado Desert slopes gently southward to the ocean level at the head of the Gulf of California, north of which there is an arid tract of the surface, which is actually lower than the surface of the sea, believed to have a depression in its centre of 300 feet,—a region of continual depression, from which the dry winds have lapped up the remnant waters of the Gulf of California, and annually drink away every trace of the back waters of the Rio Colorado, at the season of its rise from the rains in the mountains. In some localities along the western edge of the Colorado Desert, the rounded water-worn pebbles which strew the surface are beautifully polished, from the action of the sharp dry sand driven furiously over the gravelly pavement by the prevailing westerly winds; and in several of the gorges or passes through the Sierra Nevada, in the same neighborhood, the fixed rocks of the mountains are themselves smoothed and striated by the same agency.

E. THE PACIFIC MOUNTAIN CHAIN.

The third, or western belt, of the great elevated mountain zone of Western North America, is the oceanic chain which runs adjacent to the Pacific from Russian America to the peninsula of Lower California. The northern section of this chain traversing Russia and British America, is sometimes called the Pacific Alps ; the middle section, from Frazer's River to the Klamath, the Cascade Range ; and the southern section, lapping past part of the southern end of the latter, and extending from the Columbia River to about lat. 35°, and becoming extinct in the San Bernadino country, is called the Sierra Nevada. The central ridge of the peninsula of Lower California, a part of the same great Pacific chain, is the southward prolongation of a parallel mountain axis, which, in Middle and Northern California ranges parallel to the Sierra Nevada, west of it, and close to the Pacific coast, and is there known as the Coast Mountains. Low in its southern sections, this great mountain chain in Middle California, Oregon, and Russian America is broad, complex, and very lofty, its main central crests containing nearly the highest summits upon the continent. The Sierra Nevada, a great watershed insulating the high rainless plateau of Utah from the basin of California and from the sea, carries a very elevated crest, many parts of which reach a height of 10,000 feet ; but it has few insulated peaks towering above this line. The Cascade range, on the contrary, wholly different in its geological structure, being largely volcanic, is cleft nearly to the sea level in many places, and yet bears some of the most colossal conical summits to be met with on the globe. The three great volcanic peaks, Mount Jefferson, Mount Hood, and Mount St. Helen's, tower in great masses to the height of 15,500 feet, and even above this. Mount Fair-weather, 14,782 feet high, and Mount St. Elias 17,850 feet, are both volcanoes, believed to be occasionally active ; while Mount St. Helen's and Mount Regnier, though rather torpid, are known to be occasionally in eruption. About latitude 35°, the Sierra Nevada and the coast range diverge northward, to enclose between them the gold-producing valley of California.

The geological constitution of the Pacific chain differs in its different sections. The Sierra Nevada, peninsular chain and coast mountains, consists largely of the azoic or semi-crystalline strata, with belts of the gneissic and true plutonic rocks, in some parts of their higher crests, and in less proportion, the older palæozoic rocks low upon their flanks. The Cascade chain, commencing in the huge extinct volcano Mount Shaste, and crossing the Klamath, Columbia, and Frazer rivers, dividing the northern desert from the Pacific slope, is composed entirely of comparatively recent volcanic emissions, though in some tracts it contains also belts of the older crystalline rocks. This mixed volcanic and plutonic character appears to characterize this chain throughout its long course into Russian America.

F. THE PACIFIC OR WESTERN SLOPE.

Between the great Pacific chain and the western shore of the continent there extends the very long and comparatively narrow Pacific slope, everywhere declining, more or less steeply, to the sea. Slender in the California peninsula, it widens north of lat. 34° to admit the coast mountains and the gold-bearing valley of upper California, here presenting three subordinate belts, covering a breadth of about 100 miles, which dimension it maintains to Vancouver's Island, and beyond it. From the valley of the Sacramento, northward, its surface becomes more rugged.

The geological constitution of the Pacific slope is considerably more diversified than that of the Atlantic slope, descending eastward from the Appalachians. It consists generally of tertiary strata, mainly of miocene age: eocene, pliocene, and pleistocene, having also been recognised. These tertiaries are generally undulated and broken from violent crust movements, and in some quarters they are extensively penetrated by eruptive volcanic rocks; in other tracts the older azoic and palæozoic rocks, and still more ancient gneissic strata, forming the spurs of the coast range, intrude themselves through the tertiaries, which have probably been deposited around these ancient masses while they were above the waters.

G. THE ATLANTIC OR EASTERN SLOPE.

This long and slender zone stretches from the Gulf of St. Lawrence to the Gulf of Mexico, and descends with a gentle lateral slope from the base of the Appalachians to the Atlantic coast. Its several subordinate belts differ both in physical features and geological structure. One subdivision, ranging from the Gulf of St. Lawrence to the Hudson, through New Brunswick and New England, has a hilly surface, and many rivers, which meet the tidal level far inland from the sea. It contains short chains of rounded hills, some of them mountains in size, and it is spotted with a multitude of clear lakes and ponds, and it is throughout admirably watered. This region forms one general slope to the sea, not being fringed on its ocean border, as the corresponding zone further south is, by a true tide-water tertiary plain.

In its geological composition, this north-eastern division of the Atlantic slope consists generally of the older crystalline rocks, with palæozoic strata resting upon them. Its entire surface is covered with northern pleistocene drift, to so great a depth in some tracts as effectually to conceal the formations underneath. The limpidness of its streams and lakes must be attributed mainly to the filtering action of this sandy and gravelly bolder drift, which contains but little dispersed clay, though beds of pure brick clay regularly stratified do occasionally occur in it.

The south-western section of the Atlantic slope, expanding southwestward from the Hudson, attains in Virginia a width of at least 200 miles, under which it continues to the southern end of the Appalachians. It includes two parallel belts, quite distinct in their geology and scenery; that nearest the mountains is a true slope, descending from a height of several hundred feet to the level of the tide; that bordering the sea is a low monotonous and very level plain. Between the slope and the plain runs a well defined line of demarcation, indicated in a sudden change in the topography, and in the abrupt transition in all the streams, from rapids to the ebb and flow of the tide. Upon this physical boundary are seated all the chief cities of the Atlantic sea-board, from Trenton, in New Jersey, to Halifax, in North Carolina. This line marks, indeed, an ancient sea coast of the earlier continent in the times anterior to the elevation of the horizontal tertiary deposits.

The upper, or Appalachian division of the Atlantic slope, traced south-westward, ascends from the level of the tide at the Hudson, to its maximum height of 1000 feet near the sources of the Roanoke, and declines again beyond the Catawba, to a more moderate level in middle Alabama. From Long Island Sound to the Potomac its surface is varied and pleasing, and its soil very fertile.

Geologically, this belt includes tracts of the gneissic series, and synclinal troughs of the most ancient palæozoic formations—all in a more or less metamorphic condition. These are overlaid by a zone of middle secondary red sandstone, of older Jurassic age. This zone embraces low rugged wooden ridges, and hills of trapean and other gneous rocks. It possesses many broad, fruitful, and salubrious valleys; is singularly well watered by clear running brooks, but is nowhere marshy, and is altogether the garden spot of the Atlantic border of the continent.

From the Potomac, south-westward, the features of this slope are more monotonous, the soil less fertile, consisting of light sands and meagre clays, produced from the subjacent talcose and chloritic schists, and other altered azoic rocks. The climate is less temperate, being liable to great heat in summer, and to heavy rains, which wash its pulverulent soil. These conditions of soil and climate impart excessive turbidness to its swiftly flowing streams, causing indirectly extensive sand bars and shoals at the mouths of its rivers and estuaries, tending to block the navigation. Immediately at the base of the blue ridge, in Virginia and North Carolina, this region contains highly fertile and picturesque tracts.

The Atlantic Plain, or sea-board belt of the Atlantic slope, nowhere rises above 100 feet from the ocean level. From Long Island to North Carolina, though intersected by many tidal creeks, it is not marshy, except near the ocean, and bordering the estuaries of the Delaware and Chesapeake; but farther to the south-west, through North and South Carolina, Georgia, and Florida, its seaward half is excessively swampy and much overflowed.

Geologically, this ocean border is composed exclusively of cretaceous and tertiary deposits: the former consisting of clays and sands, including thick wide spread beds of pulverulent green sand, greatly valued as a fertilizer for the soil; the latter or tertiary of sands, clays, and beds of shell marl, with few or no concreted rocky layers. The cretaceous strata outcrop along the continental side of this plain in a narrow zone, extending from the northern sea coast of New Jersey to the Chesapeake, and reappear again low upon some of the rivers of the Carolinas and Georgia; but, throughout a large part of the plain, they are deeply covered by the tertiaries. The eocene tertiary strata have a narrow long line of outcrop in a corresponding position along the western edge of the plain, from the Potomac to the Cape Fear River; they reappear again from under the middle tertiary beds, in a more central position in the plain, from the Cape Fear River to the Altamaha. Still farther to the south-west, these eocene beds fringe the southern edge of the cretaceous regions of Georgia, Alabama, and Mississippi, south of the termination of the Appalachian Mountains. This wide southern tract of eocene extends southwards into the interior of the peninsula of Florida, showing this peninsula to have originated as early at least as the morning period of the tertiary day.

The miocene tertiaries cover nearly the whole of the tide-water plain, except the narrow eocene strip on the west, and a pliocene area on the sea coast of Virginia and North Carolina, from southern New Jersey, through Delaware, Maryland, Virginia, and North Carolina.

The pliocene deposits skirt, at intervals, the entire Atlantic sea coast from the Chesapeake to Florida, and also the whole coast of the Gulf of Mexico, from Florida to Texas; forming, for the most part, a fringe to the eocine beds, the miocene not having been deposited in these regions.

GEOLOGICAL FEATURES OF THE UNITED STATES.

Turning, next, to a more special description of the geological features of the United States, the speaker sketched briefly the great natural areas occupied by its separate formations.

1st. To the north of the east and west Lawrentine watershed, which itself consists generally of the ancient crystalline rocks, including the older metamorphic or gneissic, later metamorphic or azoic, or non-fossiliferous palæozoic strata, and many plutonic outbursts;—there extends to a high latitude, and filling a part of the natural hydrographic basin of Hudson Bay, an area or basin of fossiliferous palæozoic strata of the upper Silurian, Devonian, and possibly Carboniferous periods. This may be called the Hudson Bay, or Arctic Palæozoic Basin.

To the south of the before-mentioned Lawrentine igneous watershed, and westward from the Atlantic slope to the Rocky Mountains, and even to the great Pacific chain, and probably north-westward to the basin of Mackenzie River, there spreads another still larger palæozoic basin. The south-eastern and best developed part of this area, from the Appalachians to the plains of Kanzas and Nebraska, entitled the Appalachian Basin, includes formations of all the palæozoic periods known to geologists, from the dawn of life upon the globe, to the close of the age of the coal.

From this brief statement of the two basins, and an inspection of the geological map, it appears that the Appalachian Basin, or that south of the Lawrentian Lakes, was depressed or under water in the earlier palæozoic periods, while the region north of the Lawrentine watershed was above the level of the sea. But at the close of the Cambrian or older Silurian ages, that great disturbance of the crust, which let the ocean in upon the area of the present basin of Hudson Bay, for the production of the Silurian and later strata, lifted out a part, and shallowed other portions of the sea-bed of the other, or Appalachian Basin, to the south. This is manifested in a break in the sequence of the strata, wherever the older Silurian or Cambrian, and the later palæozoic rocks are there recognisable together.

The first stage, then, in the physical geography of the primeval North America, was the existence of a small northern continent, the southern coast of which was nearly coincident with the northern skirt of the present valley of the St. Lawrence and its lakes. This continent, or nucleus of one, sent forward to the south a long peninsular tract, the vestiges of which we may discern in the hypozoic and azoic belt of the Atlantic slope, stretching from New Brunswick to Georgia. Very possibly other lands lay to the eastward of this region of the Atlantic slope at that early date, and were depressed during some of the earlier oscillations of the crust in this quarter of the hemisphere; the seeming eastern origin of many of the Appalachian palæozoic strata, to the coal rocks inclusive, is eminently suggestive of the existence in the palæozoic times, of some such large tract of land, and ancient Atlantis, now under the bed of the western part of the Atlantic.

The next general movement of the crust, in the region now constituting the eastern half of North America, was at the end of the coal period, manifestly an epoch of very extensive uplift of the continent. This shift of level, and total drainage of the eastern half of the Appalachian sea-bed, caused a large accession to the continent, the new shore of which, if assumed to be coincident with the line which now separates the palæozoic Appalachian formations, and yet older ones of the Atlantic slope, from the later horizontal cretaceous and tertiary deposits that fringe them, was that well marked physical limit already partially traced as the inner edge of the low tertiary and cretaceous plain. Probably, however, this newly-produced part of the continent, particularly on its western side, was somewhat more extended at the date of elevation than the present margin of the cretaceous formation indicates; for it is upon this supposition, coupled with a belief that the newly uplifted formations remained out of water, under somewhat wider boundaries than they now exhibit, that we can best explain the non-existence of any Permian and Triassic formations between the Carboniferous, the latest of the American palæozoics, and the Cretaceous, the next more recent sediments deposited against them. During all the long geological ages which intervened between the lifting out the palæozoic region of the United States east of the Missouri, and the deposition of the Cretaceous strata, no sedimentary formations of the Mesozoic periods, such as those which fill large tracts in other quarters of the globe, were permanently upraised into dry land, saving only a few narrow strips—products of estuary sedimentation—stretching at intervals along the Atlantic slope from Prince Edward's Island to Carolina. Elsewhere, certainly as far westward as the Rocky Mountains, either nothing was deposited during the permian, triassic, and jurassic ages, or, what is far more probable, the formations then produced were formed outside of the present palæozoic limits, and have been covered up from sight by the wider sediments of the cretaceous sea, which, lapping over them, have shut in all the earliest border tracts of the palæozoic lands, formed at the end of the coal period.

The nature of the crust movements which elevated the palæozoic strata was in the region of maximum disturbance—that of the Atlantic slope and Appalachian chain,—a stupendous undulation or wave-like pulsation, the strata being elevated into permanent anticlinal and synclinal flexures remarkable for their wave-like parallelism, and for their steady declining gradation of curvature, when they are compared in any east and west section across the corrugated zone. To the westward of the Appalachian chain, where this structure is so conspicuous, the crust waves flatten out, recede from each other, and vanish into general horizontality; and this nearly level condition extends thence throughout all the older rocks to the plains of Texas and Nebraska, where the cretaceous beds overlap them. The orographic features of the Appalachian chain, even to the minutest slopes and terraces upon the flanks of the ridges, are all beautifully impressive of the carving action of deep retreating waters.

The cretaceous deposits of the United States all imply a marine origin, no fresh water remains having hitherto been discovered among them; and the geological map now exhibited pictures approximately the wide extent of the cretaceous, or later mesozoic sea, as it washed the boundaries of the palæozoic continent. The shore of that sea was, as before hinted, the inner edge of the Atlantic plain on the east; on the south it was the southern termination of the Appalachian chain and the other great north-east and south-west palæozoic tract, west of the present Mississippi; and on the west, for a long distance northward, it coincided generally with the present valley of the Upper Missouri. This cretaceous sea lapped round the southern end of the Rocky Mountains, and spread as far to the west as the Cordilleras of New Mexico and the Wahsatch chain of Utah. We do not at present know that it extended any further.

The close of the cretaceous or chalk period was marked by the rise and desiccation of nearly the whole now continental area of this great northern Mediterranean. The movement along the Atlantic border of the continent was comparatively slight, for it brought above the sea level only very limited and narrow tracts of the shoal water cretaceous sediments. South of the Appalachian region it was somewhat more extensive, elevating a wider zone between the previous dry land and the newly formed tertiary shore; but to the west of the region of older rocks it was a broad continental rising, draining dry nearly the whole bed of the then existing ocean to the limit indicated beyond the Rocky Mountains. The coast line established by this lift of the crust, set new and much more restricted bounds westward and northward to the Atlantic Ocean, and established the outlines of the present Gulf of Mexico, which thus dates back as far as the commencement of the eocene tertiary age. It does not seem probable that Florida was then any part of the dry land, the true southern peninsula of the continent being rather the newly formed cretaceous plain at the end of the Appalanchians.

From that date, the movements in the level of the continent have been manifestly less and less. Its great outlines, established at the close of the chalk period, have remained as its contour to the present day; and each successive gain of territory, during the several tertiary revolutions —that which ended the eocene, that which closed the miocene, and that which cut-off the pliocene, and even the pleistocene deposits, was but an enlargement of the primitive mesozoic pattern, a mere addition of a lighter and lighter fringe to the broad mantle of land, which earlier convulsions had constructed.

(To be Continued.)

AMERICAN PATENTS.

List of American Patents which issued from March 10th, to March 31st, 1857, (inclusive,) with Exemplifications.

MARCH 10.

73. For an *Improvement in Stop Motions for Steam;* John T. Ackley, Philadelphia, Pennsylvania.

Claim.—"The rod with its nuts, in combination with the spring lever having two fulcrums, and the spring catch lever, the said rod being operated (in case of accident,) by the cross-head of the steam engine, or other convenient working part of the same, and the said catch lever being connected to the eccentric rod, or to a stop-valve in the steam pipe."

74. For an *Improvement in Cut-offs of Steam Engines;* John F. Allen, City of New York.

"This invention consists in a certian mode of applying and operating the cut-off of a slide valve engine, for the purpose of cutting off the steam instantaneously, without any previous unnecessary contraction of the opening of the port at any point between the commencement of the stroke and the half-stroke of the piston."

Claim.—"1st, The arrangement of the sliding cut-off valves to work on a separate seat, arranged inside of the seat of the main valve, and having precisely similar arrangement of ports to the seat of the main slide valve. 2d, The foot pieces and levers attached to opposite ends of the main slide valve, and operating in connexion with pistons that are attached to the cut-off valves, and work in cylinders connected with the main steam passages, and with spring catches that retain the said pistons and adjustable sliding pieces, or their equivalents."

75. For an *Improved Machine for Grinding Saws;* Emanuel Andrews, Elmira, New York.

"The nature of my invention consists in the use of two stones, in combination with the rollers, for the purpose of grinding on a taper—each stone acting independent of the other—the saw revolving faster when the stones are at or near the centre, than when at the edge of the same."

Claim.—"1st, Connecting the saw to the mandrel by the ball joint, for the purpose of adjusting it to the position of the rollers while being operated on by the stones, whether these act conjointly or independently, and to prevent straining the saw. 2d, The plate, for the purpose of allowing me to guide and grind a saw even in thickness, regardless of its hard or soft parts, thus perfectly balancing the saw."

76. For an *Improvement in Manufacture of Felt Cloth;* George G. Bishop, Norwalk, Connecticut.

Claim.—"In contradistinction from forming a bat for felt cloth, by carding from laps a bat made from ropings or rovings."

77. For an *Improvement in Casting Plates for Artificial Teeth of Alloys;* Alfred A. Blandy, Baltimore, Maryland; ante-dated Dec. 11, 1856.

Claim.—"Casting the plates of artificial teeth of an alloy suitable for such a purpose from its chemical aad physical properties, and that practically will not shrink or expand on solidifying."

78. For an *Improvement in Converting a Lifting Pump into a Suction and Forcing Pump, or vice versa;* John F. Brickley, Winchester, Indiana.

Claim.—"So arranging a rod in connexion with the valve of the pump, as that said valve may be closed or opened at pleasure by the user, for converting an ordinary lifting pump into a suction and forcing pump, or vice versa."

79. For an *Improvement in Melodeons;* Riley Burditt and Hatsell P. Green, Brattleboro', Vermont.

Claim.—"Having the fulcrum of all the connecting levers located upon a single movable board."

80. For an *Improvement in Rock Drills;* Thomas H. Burridge, St. Louis, Missouri.

Claim.—"The combination of the sliding head with the ratchet guide piece, bumper spring, rod, and drill bar, when said parts are constructed and arranged for joint operation."

81. For an *Improvement in Harvesters;* Hiram Clark, Rochester, New York.

Claim.—"Giving to each of the cutting bars alternately, an advancing upward stroke against the grain."

82. For an *Improvement in Machines for Harvesting Grain;* George R. Crane, Caldwell, New Jersey.

Claim.—"Operating the bars to which the rake teeth are attached, from left to right, by means of the straps, roller, cord, and spring, when the same are constructed and arranged in relation to each other within the divider or shield."

83. For an *Improvement in Machinery for Making Wire Rope;* Joseph Cushman, Racine, Wisconsin.

Claim.—"1st, The arrangement of the two sets of reels, in combination with the carriage, whereby the strands may all be adjusted and drawn out to the proper length simultaneously. 2d, The swinging arms, in combination with the traveling top."

84. For *Improved Devices for Raising or Lowering Farm Gates, to allow them to open over obstacles;* Dennis E. Fenn, Tallmadge, Ohio.

Claim.—"The section with the slot, spring, stud, section, arm, and the notched plate. Also, the slide and pawl."

85. For an *Improved Escutcheon for Key-holes;* Edmund Field, Greenwich, Conn.

Claim.—"The key-hole drop, composed of two parts pivoted together."

86. For an *Improved Method of Preventing Dust, &c., from entering the Windows of Railroad Cars;* Philip M. Pyfer, Baltimore, Maryland.

Claim.—"The arrangement of rotary fans, or their equivalents, upon the outside of the body of the car, when employed in conjunction with the windows thereof."

87. For an *Improvement in Steam Spades;* George Morton Ramsay, City of N. York.

Claim.—"The alternate spades, in combination with the double crank shafts."

88. For an *Improved Guard for Breast-Pins;* James M. Ross, Springfield, Mass.

Claim.—"The additional guard as applied."

89. For an *Improvement in Valve Gear of Direct-action Steam Engines;* James P. Ross, Lewisburgh, Pennsylvania.

Claim.—"The elastic lever, applied and operating in combination with the oscillating yoke, the traveler, and the roller, or its equivalent."

90. For *Improved Fluid Gates or Faucets;* Jared W. Smith, Hartford, Conn.

Claim.—"The slide, guided, secured and made adjustable by the screw-pin and nut, having a guiding flanch to travel within guide strips, when the same are used in connexion with an operating lever, loosely connected by recess with said slide for the more convenient removal of the parts and retention of the slide in case of breakage of the lever, and for the more free and independent operation of the parts, and so that the bolt holds the slide without the aid of the lever. Also, in combination of the lever and slide, or therewith the fulcrums, at different distances from the centre of the slide and slotted arm."

91. For an *Improved Chuck for Watchmakers' Lathes;* William Stephens, Richmond, Indiana.

Claim.—"The sliding or adjustable jaws, in combination with the sliding or adjustable back centre rod."

92. For an *Improved Table Gauge for Circular Sawing Machines;* M. B. Tidey, Ithaca, New York.

Claim.—"The construction of a portable saw gauge."

93. For an *Improved Mode of Supporting the Tongues of Coaches;* Zalmon B. Wakeman, Beloit, Wisconsin.

Claim.—"The use of the brace or braces, or their equivalents, attached to the reach (or perch) of a wagon, or other carriage, in combination with a spiral spring or spiral springs applied to the tongue of a wagon, or other carriage, and pressing against the reach for the purpose of giving direction and steadiness to the tongue by checking its motion sidewise, keeping it in a straight line with the reach (or perch,) while it supports it, and also preserves the set of axle in its true position. Also, the arrangement and combination of parts, for the purpose of giving direction and steadiness to the tongue while it supports it."

94. For an *Improved Circular Sawing Machine;* C. P. S. Wardwell, Lake Village, New Hampshire.

Claim.—"The arrangement of two or more saws or cutters in a swinging frame, so that either saw or cutter may be brought into a suitable position for action, while at the same time the other or others shall be removed from the way, in the manner specified or in any equivalent manner: and this I claim whether or not a central or axial saw or cutter is combined therewith, or with a single swinging saw or cutter."

95. For an *Improvement in Grain Cradles;* Samuel D. Warren, Lebanon, Alabama.

Claim.—"The combination of the standards, fingers, and sneed, when so made and united as that by the bar, said fingers may be gathered or adjusted."

96. For an *Improved Method of operating the Splitting Knife in Hoop Pole Machines;* Carver Washburn, Bridgewater, Massachusetts.

Claim.—"The improvement of applying a knife to the feed rollers, or the latter to the former, so that one may be made to approach towards and recede from the other."

97. For an *Improvement in Machines for Stamping Figures in Carpenter's Squares;* Heman Whipple, Shaftsbury, Vermont.

Claim.—"1st, The arrangement of a series of chase bars jointed at one side of the machine, when combined with the anvil sustaining the square, and with the hand-wheel, rack, or racks, and pawl, for regulating the relative positions of the anvil and chase bars. 2d, The arrangement of the levers, and bolt, bars, and slot, and pin, whereby the one motion of the lever (by the treadle,) first turns the bar around to confine the chase bar, and then gives the requisite compression of the chase bar at both ends on to the square or plate on the anvil, to retain the same firmly, while the chases are being separately struck into said squares."

98. For an *Improved Self-Regulating Wind-Wheel;* Abner P. Wilson, Salem, Ill.

Claim.—"Constructing the sails of two parts attached or fitted to inclined frames which are secured to the arms, the upper parts of the sails being hinged to their frames, and having weights and cords attached."

99. For an *Improved Bomb for Killing Whales;* Nathan Scholfield, Assignor to self and Wm. W. Wright, Norwich, Connecticut.

Claim.—"1st, Inserting the end of the fuse through a short holding pipe or collar, and securing it firmly therein by compressing the same, and the drawing or forcing this within the end of the fuse pipe, having a conical enlargement at its rear end. 2d, Enlarging the end fuse cord by winding it with twine, or its equiavalent, so that it cannot be drawn through the pipe, and inserting it in the fuse pipe either with or without the fastening pipe, and the putting gypsum, brimstone, or wax around it, within the nut, to hold it securely. 3d, The application of the sliding collar on a projectile carrying a cylindric metallic plate covering the projectile, and either slit to form wings, or unslit as a cylindric case, and so constructed that the said collar, with the case or wings, shall slide to the rear, after being discharged from the gun either by the action of a spring or the resistance of the air to guide its direction. 4th, So constructing and applying these wings, that they may coincide with the cylindric surface of the projectile while in the gun, and that their rear ends may be thrown up therefrom by their elasticity after being discharged, so as to stand in position diverging from that surface in the rear."

100. For an *Improved Device by which the Spigot of Gas Cocks may be Lubricated in their Seats;* Charles H. Johnson, Assignor to self and James G. Hamblin, Boston, Massachusetts.

Claim.—"When the tapering plug of the faucet or stop-cock is drawn into the tubular seat by the action of the spring combining with the seat tube an entrance passage and groove, and a movablo stop, arranged so as to enable a person to expeditiously lubricate the stop-cock without the necessity of entirely removing its plug from its seat tube."

101. For a *Second Anchor Shackle;* George Gilmour, Assignor to self and Henry R. Clinkard, Chelsea, Massachusetts.

Claim.—"My new or improved anchor shackle, as made with a spring pawl and trigger, or latching apparatus, arranged in reference to the roller. Also, making the pawl forked or with a recess, so as to enable it to straddle the chain."

102. For an *Improved Machine for Coiling Steel Springs;* Perry G. Gardner, City of New York.

Claim.—"1st, The cone mandrel constructed in two pieces, so that the spiral cone will slide off and upon the straight part of the mandrel, the straight part having the slot or groove, and being an eccentric, so that one edge of the slot will be lower than the other, and gradually rising round to the other edge or side of the mandrel. 2d, The construction and arrangement of the sliding frame, for carrying or feeding up the steel plate upon the cone mandrel, and having attached to it the table, self-adjustable to any required inclination, for supporting and holding the steel plate while being drawn in upon the mandrel, and sustaining the adjustable rollers with their adjustments to meet any required thickness of the steel plate. 3d, The arrangement of the loose or sliding pressure roller, so as to have the lateral motion upon the axle by means of the arms attached to the sliding frame, and the simultaneous graduated downward movement to press and guide the steel plate upon the spiral cone. 4th, The combination of the sliding frame and the parts attached to it, and the pressure roller, and the intermediate guide plate, with the cone mandrel arranged and operating in a direct motion. 5th, The arrangement by which the wheel is thrown in and out of gear so as to connect or disconnect the shaft, with the shaft by which connexion or disconnexion may be made by hand, or by the operation of the machine itself at the required movement."

103. For an *Improved Machine for Shearing Steel Plates;* Perry G. Gardner, City of New York.

Claim.—"The arrangement of the movable bracket plate, so as to adjust the lower steel cutter to the upper steel cutter as required, the adjustable stop or guide plates, and the guide bars upon the tables attached to the eccentric lever, the whole combined, arranged, and operating in connexion with the shears."

104. For an *Improved Method of Operating Saw-mill Dogs;* George W. Hearn, Princess Ann, Maryland.

Claim.—"The longitudinally moving shaft, in combination with the shaft and the clutches."

105. For an *Improvement in Lubricators for Steam Engine Cylinders;* John Henwood, City of New York.

Claim.—"The piston having the oil cup attached by a hollow stem, and provided with a valve working in an oil cylinder, that is provided with an arrangement of passages leading to the steam cylinder valve chest, or other part to be lubricated, and with a cock, having an arrangement of passages to correspond with said passages from the oil cylinder."

106. For an *Improved Nipple for Discharging or Withdrawing Cartridges from Breech Loading Fire Arms;* Wm. Cleveland Hicks, New Haven, Conn.

Claim.—"1st, My improved nipples (two or more prongs with or without hooks for withdrawing loaded balls or cartridges from breech loading fire arms), for the purpose of igniting percussion, and discharging loaded balls or cartridges from breech loading fire arms. 2d, My method of using one, two, or more, nipples or prongs, with hooks to withdraw cartridges or loaded balls from breech loading fire arms, by causing said hooks to indent or spring the rim of a cap or primer, and by catching hold of said rim to withdraw the loaded ball or cartridge by the act of drawing back the nipples."

107. For an *Improvement in Enameling Cast Iron;* George W. Holley, Niagara, New York.

"The nature of my invention consists in providing what I call a skeleton or core plate for non-tubular surfaces, corresponding in surface as nearly as may be to the surface of the pattern which is to be moulded, in which mould, when prepared, the iron to be coated or covered with any given composition is to be cast. This skeleton or core plate is to be covered with sand, properly prepared with sour flour or molasses on the side on which it is proposed to coat or cover the cast iron plate with any given composition."

Claim.—"The process of covering the skeleton or core plate, and core rod, with the compound or composition with which it is proposed to coat or cover the iron, and then pouring the melted iron on and around said compound or composition, and melting or softening the same so that it well adhere to the surface of the iron as it becomes cold. The same process may be used for coating or covering copper, brass, and other metals."

108. For a *Fire-proof Stone;* Thomas Hodgson, Brooklyn, New York.

Claim.—"The useful manufacture of a fire-proof artificial stone, composed of feldspar, mica, and quartz, and the other substances or materials."

109. For an *Improved Machine for Forming the Curved Surface of Solid Wooden Chair Seats;* Edwin, Artemas, and Cheney Kilburn, Burlington, Vermont.

Claim.—"Shaping or hollowing out the faces or upper sides of chair seats, by means of a grinding or cutting wheel, when said wheel has a convex place or periphery coated with sand, emery, or other suitable substance, and using in conjunction with said wheel, the screw, or its equivalent, with the circular plate or disk attached."

110. For an *Improved Hydraulic Jack;* George Lindsay, City of New York.

Claim.—"The arrangement of them all combined, as constituting the specific whole machine."

111. For an *Improved Arrangement of Carriage Springs;* Charles A. McElroy, Delaware, Ohio.

Claim.—"The springs pivoted, and stirrups."

112. For an *Improved Machine for Cutting Screws;* Thompson Newbury, Taunton, Massachusetts.

Claim.—"The jointed elevator, passing through the bottom of the feed pan. Also, the vibrating slotted guide pace fixed to the carrier shaft, operated by arm and pin. Also, giving the threading tool for the purpose of pointing the blank, a motion independent of, and slower than, that required to effect the threading. Also, the catch-wheel with its pawl and stop, in combination with the leader worm."

113. For an *Improved Roller for Bending Sheet Metal;* Daniel Newton, Southington, Connecticut.

"The nature of my invention consists in preparing the outside roller for double seaming, with an angular groove turned into it, in which the seam runs in the first revolution, thus setting it down or pressing the seam together, and bending it over both at the same instant."

Claim.—"The application to double seaming machines of a roller containing an angular groove, in which the seam runs in the first revolution."

114. For an *Improved Carpenter's Plane;* Oldin Nichols, Lowell, Massachusetts.

Claim.—"Connecting the cap to the plane wire by the hook headed bolt, with two nuts, and thereon to hold them together, and then securing the iron to the plane stock by a cam shaft, operating upon this same hook headed bolt, which is so adjustable as to be lengthened or shortened, that any desired pressure may always be had to firmly hold the iron to the stock by turning the cam shaft, and still allow the plane iron to be moved in or out of the plane to cut a thick or thin shaving, without farther tightening or loosening it. Also, the plate secured to the plane stock, and intervening between the surface of the hook and the surface of the cam shaft, to prevent wear of the hook and cam, and also to prevent the hook and plane iron from sliding back when the cam shaft is turned to tighten the iron to the plane stock. Also, the application of one single handle to answer for, and be secured to, a whole set or any number of plane stocks, either in the lower or elevated position, and changeable from one position to another, or from one plane to another instantly, and be secured firmly thereto by means of the hook and cam, or their mechanical equivalents."

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115. For an *Improvement in Enema-giving Apparatus;* Benjamin T. Babbitt, City of New York.

Claim.—"The combination of the portable reservoir, the flexible tube, and the nozzle, to form a portable apparatus, for the purpose of giving enemas or injections by hydrostatic pressure."

116. For an *Improvement in Machinery for Felting Hat Bodies;* James B. Blakslee, Newtown, and E. R. Barnes, Brookfield, Connecticut.

Claim.—"Giving to the endless rotating bed of felting machines, periods of rest during the continuous motion of the upper deck."

117. For an *Improvement in Power Looms;* John L. Cheney, Lowell, Mass.

Claim.—"My improved picker motion or mechanism, as made with a guard stand, and rocker, a stationary guide and a stud or roller, and with reference to the picker staff. Also, so arranging the top bearing surface of the stand of the rocker, that it may incline downward, and so as to obtain all the advantages of a spring, without the actual application or use of the same, meaning to claim such an arrangement of the top surface, with respect to the rocker and staff, as an improved equivalent to the spring."

118. For an *Improvement in Lard Lamps;* Isaac N. Coffin, Washington, D. C.

Claim.—"The combination of the flat inclined wick tubes, at right angles to each other, with the concave reflector."

119. For an *Improved Rotary Printing Press;* John C. Davis and Wm. Miller, Elizabeth, New Jersey.

Claim.—"The combination of the rollers with the shoes, and the inclination of the ways (or planes), and the upright screws for operating the type bed."

120. For an *Improved Mode of Veneering the Walls of Buildings;* George B. Field. St. Louis, Missouri, and Benjamin F. Field, Beloit, Wisconsin.

Claim.—"The mode or manner of securing these thin plates of slate or marble, to the walls and ceilings of buildings which have been previously built, meaning the combined arrangement of the strips of wood, cement, and screws, or the alternative method of the angle irons or window and door casings, pilasters, cornice string courses, or other ornamental attachments, combined with the cement, for the same purpose."

121. For an *Improvement in Telegraphic Repeaters;* Moses G. Farmer, Salem, Mass., and Asa F. Woodman, Portland, Maine.

Claim.—"The use of a mechanical obstacle, whereby, when the independent circuit has broken the dependent circuit at the instrument, the dependent circuit is prevented from breaking the independent circuit."

122. For an *Improved Bill Holder;* E. F. French, Franklin, Vermont.

Claim.—"The pockets placed between the two lids or covers; the pockets and lids being connected by a cord, and having a rod or axis passing through them at one end."

123. For an *Improved Gas Generator;* Alonzo M. Giles, Boston, Massachusetts.

Claim.—"The inner door operating whereby the heat of the retort is rendered much more intense and uniform. Also, the pipes, in combination with the inner door."

124. For an *Improved Hinge;* Kingston Goddard, Philadelphia, Pennsylvania.

Claim.—"The socket in the end (or adjusted to the end, so as to form the part thereof), of the hinge to be acted upon directly by a torsion bar—I claim only the hinges."

125. For an *Improvement in Piano Forte Action;* James A. Gray, Albany, New York.

Claim.—"The application of a spring to the hammer butt and jack-fly, causing the hammer to be so raised and kept in position that it will allow the jack-fly free play under the shoulder of the hammer butt, when the key is pressed down, and the action in motion. Also, the application of the hook to the hammer butt and jack-fly, so as to cause them to work together with more precision, and also to bring the hammer to its place after the key has been struck and released."

126. For an *Improvement in Machinery for Cleaning and Separating Cotton, Wool, Fur, and other Fibrous Materials;* Isaac Hayden, Lawrence, Mass.

Claim.—"Increasing the area of the trunk above the screen, or making it larger towards its rear end, by increasing its height or width, or both, as may be desirable, so that the blast of air which conveys the materials into or through the trunk, will move gradually slower, so as to allow the light and fine, or such portions as are intended to be separated, time to be precipitated and pass through the screen before the air, which holds them in suspension, escapes from or passes out of the trunk. Also, in combination with a trunk made gradually larger towards its rear end, I claim a screen of woven wire, or twine, arranged upon a series of partitions."

127. For an *Improvement in Machines for Stuffing Horse Collars;* Wade H. Haworth, Philadelphia, Pennsylvania.

Claim.—"1st, The employment of two stuffers, stuffing against each other from both ends of the collars, when such stuffers are made to recede automatically. 2d, The employment of two alternating sets of such stuffers, for stuffing both rolls of the collars."

128. For an *Improvement in Hernial Trusses;* Ancel I. Hardin, Shelby, N. C.

Claim.—"The position and application of the lever."

129. For an *Improvement in Harvesters;* Cornelius Holloway, Assignor to James B. Maney, Petersburgh, Va.

Claim.—"In combination with the cam connected to the frame by a link, and to the tongue by a strap or yoke, the slot at front, and the lever connexions at the rear, so that the machine may swing forward and back as it is lowered or raised, but be rigid when the draft is on."

130. For an *Improvement in Printing Presses;* Horace Hoft, Winchester, Mass.

"My invention consists in a peculiar arrangement of parts, whereby the 'form' is properly inked, the 'platen' drawn underneath the 'form', and the 'form' pressed down upon the card on the 'platen,' and the 'platen,' after the card has received its impression, is forced out from underneath the 'form.'"

Claim.—"Operating the platen by means of the cam, slide, and arm, connected with the 'platen' by the rod, and also operating the plate to which the form is attached by means of the rod connected with said plate, and made to bear against the face of the cam, when said parts are arranged so that the platen and form may be operated conjointly by the cam. Also, in combination with the means for operating the platen, the rotating and vibrating ink distributing roller. Also, throwing the printed card from the platen, by means of the levers attached respectively to the platen and plate."

131. For an *Improved Method of Cleansing Fibrous Materials;* John Howarth, Salem, Massachusetts.

Claim.—"The process of cleansing fibrous materials."

132. For an *Improvement in Brick Machines;* Almon V. Hough and Richard W. Jones, Green Castle, Indiana.

"The nature of our invention consists in the use and application of two horizontal shafts, within a perforated moulding chamber, having oval or flanched wings on one side, and arms or beaters on the other side, acting both as mixers and pressers, revolving together inversely, cutting off from above a sufficiency of mud to fill the moulds."

Claim.—"The use and application of two horizontal shafts, provided with oval or flanched wings on one side, and arms or beaters on the opposite side, in the lower perforated chamber, and in combination therewith, for the purpose of moulding and pressing the brick."

133. For an *Improvement in Harvesters;* Moses G. Hubbard, Penn Yan, New York.

Claim.—"A shifting seat, when constructed, arranged, and combined with a harvester."

134. For an *Improved Photographic Plate Vise;* John W. Jarboe, City of New York.

"This invention consists in a novel mode of applying and securing the movable jaw of a vise, which allows it to be moved any required distance to suit plates, or other articles of various sizes, and tightened upon the article in a very expeditious manner."

Claim.—"The combination of the screw and its attached cam with the movable jaw, and the sliding piece, the said jaw, and sliding piece, working in separate grooves, or their equivalents."

135. For an *Improved Mode of Compensating the Local Attraction of the Magnetic Needle on Ships;* Calvin Kline, City of New York.

Claim.—"The surrounding metallic ring or rings, or the modifications thereof, constructed, combined, and arranged with the needle of a compass."

136. For an *Improvement in Fire Arms;* Sewell K. Lovewell, Gardner, Mass.

Claim.—"The use of the spindle applied to guns of any size and calibre."

137. For an *Improvement in Convertible Cider Mill;* Samuel Males, Cincinnati, Ohio.

Claim.—"Rendering the machine readily convertible from a cider mill to a corn sheller, and vice versa, by making the concaves, hoppers, and cross beam, in the 'cylinder' and driving gear, being the same in both cases."

138. For an *Improvement in the Construction of Gas Burners;* John McHenry, Cincinnati, Ohio.

Claim.—"The removable disk as a means of varying the size of the throat of the burner."

139. For an *Improved Machine for Planing Tapering Staves;* Valentine Munck, Carrolton, Louisiana.

Claim.—"The adjustable table, and making said table guide with cutting head. Also, in combination with the table and cutting head, the angular side cutting heads, to secure from the variation of the table, tapered planing on the edges of the lumber."

140. For an *Improvement in Sewing Machines;* T. J. W. Robertson, City of New York.

Claim.—"Feeding the cloth in sewing machines by means of a hook having one or more points."

141. For an *Improvement in Cast Iron Car Wheels for Railroads;* James M. Ross, Springfield, Massachusetts.

Claim.—"My mode of constructing the plate, viz: by gradually increasing the thickness of the disk as it recedes from the hub and tread of the wheel."

142. For an *Improvement in the Burner of Burning Fluid Lamps;* Rufus W. Sargent, Philadelphia, Pennsylvania.

Claim.—"1st, The making of the chamber for the heating flame in lamps in which burning fluid, spirit gas, or other highly volatile fluid is used, so that it nearly or wholly surrounds the chamber in which the gas is generated, in order that the heating flame being sheltered from the outer air, and confined within the outer chamber, and in immediate contact with the inner chamber, may effect its purpose more steadily and with less consumption of fluid. 2d, Surrounding the burner tube with a wick and packing, in order to supply the heating flame with fluid, and the making of the burner tube with a flanch and shoulder, in order to afford space for said wick and packing, and the perforating the burner tube with apertures through which said wick may be supplied with fluid. 3d, The regulator movable up down upon the burner tube, in order to regulate and control the heating flame."

143. For an *Improved Machine for Cutting and Bending Sheet Metal;* Elliot Savage, East Berlin, Connecticut.

Claim.—"Constructing and arranging the frame which carries the clamps with respect to that which carries the cutters, that is, so that while the clamps are being forced together or made to seize a plate of metal, they shall not spread the cutters apart. Also, the mode of constructing the compound lever of the bending rollers, and arranging the rollers thereon; the said compound lever being composed of a bent lever and an arm, and the rollers being applied to them respectively. Also, combining with the clamps, their crank shaft and the bending rollers, the auxiliary crank shaft, or equivalent means, by which the bending roller may be rotated independently of force applied through the clamps, and so that the middle of the metallic plate shall not be subjected to injurious strains by the bending rollers."

144. For an *Improved Portable Reciprocating Circular Sawing Machine;* Osborne E. Stephens, McCall's Ferry, Penna.

Claim.—"A saw arranged to traverse horizontally, so as to cut a score in one side of the log to be sawed, and then moved perpendicularly, so as to traverse horizontally in the opposite direction, to cut a score in the opposite side of the log to correspond with, and cut into, the first score, and cut off a portion of the log. Also, the devices for changing automatically or by hand, the motion of the carriage which traverses the saw horizontally in each direction. Also, the devices for changing automatically, or by hand, the motion of the carriage that traverses the saw perpendicularly, Also, the latches arranged to fill the scores in the guide, so as to let it slip by the locking lever"

145. For an *Improvement in Mowing Machines;* John Taggart, Roxbury, Mass.

Claim.—"A series of rotary cutters, working in recesses or guides, in combination with a knife sharpener."

146. For an *Improvement in Metallic Seals;* Joseph Wappenstein, Philadelphia, Pa.

Claim.—"A metallic seal wafer or fastening for securing letters, packages, &c., composed of two pieces united together, and to the thing to be fastened."

147. For an *Improvement in Machines for Graduating Carpenters' Squares;* Heman Whipple, Shaftsbury, Vermont.

Claim.—"1st, The scale index mounted upon the carriage, and regulating the extent of motion given to said carriage from the truck and pusher point, whereby the length of the division mark is determined, and the cut made from the edge of the square. 2d, The arrangement of the rack lever, and its actuating cam or pin, pawl, rod, and weight, or its equivalent, for moving and adjusting the index to be acted on by the pusher. 3d, Arranging the graver stocks within the carriage, when said graver stocks are governed by the levers, adjusting rail, and springs and rods, or equivalents, for pressing down the gravers in cutting, and thus lifting the same up off the square while returning. 4th, The arrangement of the scroll cam, anvil, or bed, rod, lever, latch, incline wedge, and clutch or friction lever, for moving said bed and its square endwise, the required integral part between each stroke of the gravers, and then stopping the machine when the divisions are completed. 5th, The manner of securing the gravers in place, and bringing them to the exact position in the stocks by means of the mortise bolt."

148. For an *Improvement in Machines for Unmaking Rope or Cordage;* Joseph Wood, Brooklyn, New York.

Claim.—"The combination of the rotating roller head and the pointed mandrel."

149. For an *Improvement in Combs;* Thomas L. Calkins, Assignor to self and J. W. Bliss, Hartford, Connecticut.

Claim.—"The use of the sheath."

150. For an *Improved Piston for a Muzzle-Loading Gun;* John F. Foster and Jacob I. Banta, Jersey City, New Jersey, Assignors to selves and James H. Banta, Piermont, New York.

Claim.—"The conical packing rings on the piston. Also, the barbed fingers, in combination with the piston, to seize and draw in the ordinary cartridge."

151. For an *Improved Hand Printing Press;* Francis S. Coburn, Ipswich, Assignor to W. W. Messer, Boston, Massachusetts, and George F. Gray, Albany, N. Y.

Claim.—"The application or arrangement of the stops, and the spring, with respect to the frame and the lever, and so as to arrest the upward movement of the roller."

152. For an *Improvement in Rope Manufacture;* Michael H. Johnson, St. Louis, Mo.

Claim.—"As an improvement in the manufacture of hemp rope from the raw sliver, the combination of the condensing rollers with the callender roller and bobbin, whereby the sliver may be condensed to a greater degree than is admitted under the ordinary circumstances, governing the aforesaid manufacture with advantage."

153. For an *Improvement in Machines for Paring Apples;* Benjamin F. Joslyn, Worcester, Massachusetts.

"This invention consists in the employment or use of stationary or rotating spurs, attached to the knife rod, and placed relatively in an oblique position, and in the employment or use of a sliding mandrel, the parts being so arranged that the spurs by the rotation of the apple will feed the apple to the cutter, and cause the apple to be pared in a perfect manner."

Claim.—"The spurs, either rotating or stationary, attached or connected to the cutter rod, and placed obliquely or angularly with the apple or its axis of rotation, when said spurs are used in connexion with a sliding mandrel, for the purpose of feeding the apple to the cutter."

154. For an *Improvement in Baby Walkers;* Joseph Thomas, Assignor to self and Charles A. Durgin, Brooklyn, New York.

Claim.—"The combination and arrangement of a circular cushion, having attached thereto straps for confining the child in a vertical position, and also allowing it to turn at will within the cushion, which is placed upon vertical adjustable legs, for the purpose of suiting the height of the child, whereby I am enabled to make a cheap and useful article of furniture, protecting the child from injury, and assisting it in walking."

155. For a *Fireman's Mask and Respirator;* Israel P. Nelson, Assignor to self, and George N. Davis, Cambridge, Mass.

Claim.—"The mask with its tubes and valves."

156. For an *Improvement in Machinery for Combing Wool;* Michael H. Simpson, Boston, Mass.: ante-dated Sept. 17, 1856.

Claim.—"The combination and arrangement of an extra doffer and stripper, (or the equivalents therefor,) with the main card cylinder, the combing doffer, and the combing belt. Also, the improved arrangement and construction of the draft rollers, with respect to each other and the combing belt. Also, making the wires of the fringe belt to extend below the table, and to run through a passage formed between the part and the combing belt, or in the belt. Also, combining with the curved plate, when such is employed in connexion with the doffer and the combing belt, a steam heating chamber, or other suitable means of heating such plate."

157. For an *Improvement in Machines for Combing Fibrous Materials;* Milton D. Whipple, Charlestown, Assignor to A. B. Ely, Boston, Mass.

Claim.—"Inclining the comb teeth to the axis of the cylinder, and covering them with the guard at the point of draft."

158. For an *Improved Screw Wrench;* Benjamin F. Joslyn, Worcester, Mass.

"This invention consists in having the shank of the lower and stationary jaw of the wrench made hollow, so as to receive the bar of the sliding jaw, and also to receive the screw which is fitted within the hollow shank, by the side of the bar of the sliding jaw, and also to receive the screw passing through a projection on the lower end of the bar of the sliding jaw, whereby a strong and durable wrench is obtained."

Claim.—"The hollow shank with the bar of the sliding jaw fitted therein, when the above parts are used in connexion with the screw placed within the hollow shank, and by the side of the bar, the screw passing through the projection on the ends of the bar."

159. For an *Improvement in Harrows;* Sidney S. Hogle, York, Ohio.

Claim.—"Causing the forward movement of a pivoted horizontal harrow, to impart a rotary motion thereto by means of the auxiliary action of a weighted roller, or its equivalent, upon one side or the other of said harrow."

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160. For an *Improvement in Cordage Machines;* James P. Arnold, Louisville, Ky.

"My invention relates to that class of cordage machines in which two or more strands are twisted in the same machine, independently of each other, and then combined by being twisted together to form a cord."

Claim.—"1st, Flattening the outer end of the nose tube. 2d, The wedge-shaped opening between the faces of the upper portion of the jaws of the nippers. 3d, Constructing the movable jaw of the rotary nippers, so that it can yield in any direction."

161. For an *Improvement in Casting Railway Car Wheels;* Norman Aylsworth, Rochester, New York.

Claim.—"The construction of the partially tubular core for the centre of railroad car wheels, the tube being formed to within a short distance of the end of said core, and communicating with the lateral passages."

162. For an *Improvement in Rotary Pumps;* Abel Barker, Honesdale, Penna.

Claim.—"Operating the two valves by means of independent attachments, which are actuated by cam grooves in the side casings of the pump, when said valves are made to work in separate chambers, in such a manner that if either valve should get out of order, the said valve and its attachments, and also the side casing on that side of the pump, may be detached from the pump, without interfering with the perfect action of the other valve."

163. For an *Improvement in Manufacturing Cotton Flannel;* Albert S. Carleton, Clinton, Massachusetts.

Claim.—"The fabric or cotton flannel having a foundation of hard thread, and an extra filling of soft yarn upon one or both sides, from which a nap is raised."

164. For an *Improved Method of Lubricating Under Pressure;* Jacob D. Custer, Norristown, Pennsylvania.

"The nature of my invention consists in forming a chambered oil cup, for oiling steam chests, steam cylinders, steam hammers, &c., by using a globe or oil chamber, and an upper and lower vertical centre stop or valve, operated by a vertical revolving cup on a vertical cylindrical stem, a vertical stuffing box, vertical screws, and two horizontal handles, all so arranged as to form unyielding seats, and permanent, tight, and durable centre valves, which will outlast the best engines."

Claim.—"The vertical revolving cup, attached to the vertical revolving cylindrical stem, the grinding or solid centre valve at the bottom, the screw and its grinding or solid centre valve, the handles, and the stuffing box, all so combined as to form a substantial vertical centre stop revolving cup, steam chest, and steam cylinder oil cup, for steam engines, steam hammers, &c., using for that purpose brass or any other metal, which may be deemed best."

165. For an *Improvement in Shirt Studs;* John P. Derby, Cavendish, Vermont.

Claim.—"1st, Widening the wire at its base for the purpose of preventing the stud from turning in the shirt. 2d, The offset in the coil for the purpose of preventing the disengagement and loss of the stud."

166. For an *Improvement in Harvesting Machines;* George Esterly, Heart Prairie, Wisconsin.

"The nature of my invention relates to the construction of the frame of a harvesting machine, with a view to its being better balanced and adjusted on its supports, and in preventing side draft."

Claim.—"Connecting the leading truck to the main frame by means of a rigid reach or secondary frame, when said reach or frame is pivoted to the rear end of the main frame, and united to the truck by a king bolt, and arranged in relation to the driving-wheel, main frame, and platform. Also, the forked lever, lifting-piece, and spring dogs, combined and operating together for lowering the sickle beam."

167. For an *Improvement in Weather Strips for Doors, Windows, &c.;* John T. Foster and Jacob J. Banta, Jersey City, New Jersey, and James H. Banta, Piermont, New York.

"The nature of our invention consists in the use of one or more strips of metal or similar substance, inserted within deep narrow grooves or mortises, on one or more sides of a door or window, and sustained by pins in diagonal slots, in such a manner that the shutting of the door or window forces out the metallic slip or bar, bringing its edge into contact with the sill or post of the door, excluding all wind, dust, &c.; and we also make use of said weather strips on the side of the door, as a locking bar, when desired."

Claim.—"Constructing weather strips with diagonal slots taking pins in the door, in such a manner that an endwise motion given to said strip in shutting the door, shall cause the weather strip to press on to the sill or casing. Also, the manner of hanging the vertical weather strip, in connexion with the upper and lower weather strip, so that the endwise motion of the latter strips shall force said strip against the vertical door post."

168. For an *Improvement in Rotary Pumps;* George W. Griswold, Carbondale, Pa.

"The nature of my invention relates more especially to the arrangement of the eccentrics within the drum or cylinder, and to the manner of operating the cut-offs in connexion with such eccentrics."

Claim.—"The double eccentrics, with their disks or plates, formed in one piece, when operating in a drum or cylinder."

169. For an *Improved Method of Operating Double Carriages in Saw-Mills;* Franklin B. Kendall, Bath, Maine.

Claim.—"Combining the devices."

170. For an *Improvement in Clamps for Brooms;* Samuel Mason, Indian Springs, Maryland.

Claim.—"So uniting the hinged portion of the case to the handle, by means of a thong, cord, or wire, as that the leverage of the handle may be used for closing said hinged portion—thus firmly closing the case on the material to hold it rigidly in the case, and to strengthen the middle portions of the clasp."

171. For an *Improvement in Rigging Vessels;* George F. Trescot, Charleston, South Carolina.

Claim.—"A separate and distinct sail and yard, which I call a storm-yard, and sail on the lower mast, so that in event of a ship losing her top-masts, or head of lower masts, would still have her storm sails to work off a lee shore, and by the division of the shrouds, the masts are better secured, though longer, and no more weight aloft than usual."

172. For an *Improvement in Machines for Breaking Slabs or Blocks of Stone into Regular Forms;* Ira Merrill, Shelbourne Falls, Massachusetts.

Claim.—"Breaking stone into regular forms by pressure and percussion, when both are applied at the same time to the slab or block of stone to be broken."

173. For an *Improved Apparatus for Making Nitric Acid;* Philip O'Reilly, Providence, Rhode Island.

Claim.—"Purifying nitric acid, in the manufacture from chlorine and nitrous fumes."

174. For an *Improvement in Pocket Lanterns;* Andrew Ralston, West Middletown, Pennsylvania.

Claim.—"The sliding cap, the cap, and the wick tube, with its two rings or disks."

175. For an *Improved Water-Wheel;* Samuel Reynolds, Oswego, New York.

Claim.—"The radial floats above the horizontal plane, in combination with the buckets or floats below said plane, constructed narrowed where they join the radial floats, gradually increasing in width outwardly, in depth downwards, with an inclination towards the centre to their termination, making the outlet to discharge the water deeper towards the centre than towards the periphery."

176. For an *Improvement in Processes for Preparing Fertilizers;* Lawrence Reid, Barren Island, New York.

"The nature of my invention consists in making a combination of animal and earthy matters with saline ingredients, in such proportion and prepared in such manner as will form a compound of salts of ammonia, super-sulphate of lime, sulphate, dried clay, and animal matters (all established fertilizers), producing this result by the treatment of animal or fish offal, with sulphuric acid, water, bones, and clay."

Claim.—"Treating with acid only the liquid parts of the animal matter, after the same has been boiled or treated by high pressure steam, and then treating the same with bone dust and absorbents."

177. For an *Improved Portable Cross-cut Sawing Machine;* Stephen Scotton, Richmond, Indiana.

"The nature of my invention consists in placing a reciprocating saw upon a locomotive frame work—the engine being placed at right angles with the line of motion of the carriage—the saw slides being borne in adjustable guides, which allow it to be used in a horizontal movement in felling trees, and in a perpendicular for logging off together with two circular saws in swinging frames—the one swinging horizontally, the other perpendicularly."

Claim.—"1st, The combination of the saw in swinging frames, in combination with the locomotive carriage. 2d, The combination of saw and frame with the swinging saw table and sliding bar. 3d, Saw in horizontal swinging frame, in combination with the locomotive carriage."

178. For an *Improvement in Steam Brakes for Railroad Cars;* Theophilus E. Sickels, Kennett Square, Pennsylvania.

Claim.—"The so combining the use of steam, or its equivalent, with the brakes of railroad cars, as that the steam shall hold the brakes from the wheels, and its partial use or disuse admit a weight or spring to apply said brakes."

179. For an *Improvement in Operating Ships' Windlass;* Norman Smith, Stonington, Connecticut.

Claim.—"Operating the windlass for raising anchors, and for other purposes, on ship board, by means of a crank or eccentric on the axis of a capstan, or other upright shaft, through the medium of pawls attached to levers, and working in ratchets on the windlass beam."

180. For an *Improved Grappling and Dredging Machine;* Augustus Stoner, Mount Joy, Pennsylvania.

Claim.—"The combination of the machine, the supporting and lever-shifting cross-piece, the mitred shovels, the ring, or its equivalent, to sustain the apparatus and chains, so linked and constructed to operate all the levers simultaneously, and sustaining the cross-piece aforesaid."

181. For an *Improvement in Mangles;* Richard A. Stratton, Philadelphia, Penna.

Claim.—"The rollers, in combination with the movable roller, arranged and driven for the purpose of acting upon the roller, in such a manner that the cloth on the same may be efficiently mangled without winding it from one roller to another, and for the purpose of removing and replacing the said roller with facility."

182. For *Improved Saw-Mill Dogs;* John A. Taplin, Fishkill, New York.

Claim.—"The double arm rocking dogs, constructed, arranged, and operating in connexion with the wedges, in combination with the traversing carriage."

183. For an *Improved Carpenters' Plane;* M. B. Tidey, Ithaca, New York.

Claim.—"The application to the cavity of the plane stock of a metallic bit-case, and so applying it, that its lower extremity shall constitute a part of the plane's face."

184. For an *Improved Mode of Attaching Hubs to Axles;* James M. White, Xenia, Ohio.

Claim.—"The combination of the parts marked."

185. For an *Improvement in Locks;* William Whiting, Roxbury, and Henry Pickford, Boston, Massachusetts.

Claim.—"Holding the slides in the exact position to which they are raised by the tumblers, by the pressure of an elastic cushion, or its equivalent."

186. For an *Improved Mode of Regulating Velocity, and Furling the Sails of Wind-Wheels;* Frederick W. Witting, Twelve Mile Coletto Gin, Texas.

"The nature of my invention consists in the peculiar arrangement of parts, or the means employed for regulating the sails, whereby they may, by the action of the wind, be turned more or less obliquely with it, and cause the wheel to rotate with equal speed, however much the wind may vary in velocity. Also, in the peculiar means employed for folding and unfolding the sails."

Claim.—"Connecting the spindles to the sliding-rod, by means of the part pinions or segments, and a rack. Also, furling and unfurling the sails by means of the drums attached to the rod, and the cords attached to the drums and sails."

187. For an *Improved Circular Sawing Machine;* George F. Woolston, Washington, District of Columbia.

Claim.—"1st, The application and use of guard plates, in combination with knives or cutters formed in saws, or inserted therein. 2d, The manner of applying the said plates, holding them firmly, and so adjusting them as to prevent vibration of the saw."

188. For an *Improved Method of Regulating Velocity of Wind-Wheels;* A. W. Wood, Milwaukie, Wisconsin.

Claim.—"Enclosing the wind within a cylindrical case formed of two rows or series of vertical slats, one row or series of which is placed in a reverse position to the other, and encompassing said case with a gate, which may be raised and lowered on said case in any proper manner, the above parts being constructed and arranged for the purpose of regulating the speed of the wind-wheel."

189. For an *Improvement in Smut Machines;* William Zimmerman, Quincy, Ill.

"The nature of my invention consists in a series of stationary and revolving cylinders, arranged on disks from their centre outwards, roughened on both sides, so as to scour and clean the grain as it passes between them successively."

Claim.—"A series of stationary and revolving cylinders, arranged on disks, or their equivalents, from the centre outwards."

190. For an *Improvement in Railroads;* Hiram Carpenter, City of New York, Assignor to the American Iron Railway Company.

"The nature of my invention relates to the chair and its support, the object being to make an iron superstructure, cheap, durable, and with the requisite spring or yield to the rolling stock, without the use of bolts, keys, &c."

Claim.—"In combination with the tie and pedestal cast in one piece, the chairs, so constructed as to fit in or on said pedestals, and to hold the rails without the use of bolts, spikes, or keys."

191. For an *Improvement in Feeding Drill Shaft;* George C. Taft, Assignor to Henry W. Mason, Worcester, Massachusetts.

Claim.—"Combining the pawl with the vibrator lever, by a secondary lever and spring applied to them."

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192. For an *Improvement in Ploughs;* Elliot Andrus, Geneva, New York.

Claim.—"The frame for the purpose of holding the mould board, attaching the handle, and supporting the end of the wheel-shaft. Also, the manner of attaching the mould board upon pivot points, in combination with the lock and links. Also, the combination of the wheel cams and friction roller, or their equivalents, to produce the oscillating motion of the mould board."

193. For an *Improvement in Grade Delineators;* George R. Clark and Samuel Adams, Antioch, California.

Claim.—"1st, The use of a pendulum, or its equivalent, operated upon by gravitation, in combination with the cones and the friction wheels, or their equivalent. 2d, In combination with the pendulum and the cones, the arrangement of the arms, the bars, and the slides, to move the friction rollers along the cones. 3d, Combining the pendulum, or its equivalent, with the paper rolls and grade pen, or either of them, in such a manner that their respective motions may produce correct horizontal and vertical scales, or a profile of the ground traveled over by the carriage."

194. For an *Improvement in Manufacturing Yarns from mixed Cotton and Wool;* George S. Bradford, Sandlake, New York.

Claim.—"Carding through the finisher, the drawing made by covering an evenly prepared cotton drawing with wool, thereby leaving most of the wool on the outside of the finished roving card, without carding the cotton through any wool carding machine but the finisher, and hence leaving the staple of the cotton straight in the finished roving."

195. For *Portable Boats;* Robert C. Buchanan, Baltimore, Maryland.

Claim.—"The portable boat, the same consisting of the portable skeleton frame work, and unprepared canvass, secured to the frame work by lashings."

196. For an *Improvement in Steam Drying Cylinders;* John Booth, Pawtucket, R. I.

Claim.—"The arrangement of the steam and water pipes at one end of a drying cylinder."

197. For an *Improvement in Corn Cultivators;* John B. Baker, Onondaga, N. Y.

"The nature of my invention consists in constructing the forward adjusting bar, with circular brace in front or arc, which serves the double purpose of brace to said bar, and of fender to push the stalks aside without breaking them."

Claim.—"The arc or fender, in combination with the adjusting bar, whereby the stalks are laid aside, and the said bar rendered much more durable."

198. For an *Improvement in Gang Ploughs;* Jesse Frye, Springfield, Illinois.

"My invention relates to a gang or series of ploughs, so combined with a set of supporting and guiding wheels and a frame, as that the conductor mounted on the plough can adjust the width of the furrow slices, the depth and direction of the furrows, direct the turning of the plough at the end of the land, and all other things necessary to the perfect guidance and operation of the plough in question."

Claim.—"The so hanging of a gang or series of ploughs upon their stock and beam, as that the conductor upon his seat may, by a system of hand levers and connecting rods, adjust said series of ploughs to any desired depth or width of furrow."

199. For an *Improvement in Brick Machines;* James A. Dorr, Ira Hersey, and Edward G. Oldfield, City of New York.

Claim.—"The combination of the cams, eccentrics, and slotted projection, attached to a strap, with the rollers, beam, and lower pistons."

200. For an *Improved Lock;* V. R. David, Newark, Illinois.

"My invention consists in the employment or use of a stop, applied to the lock and arranged and operated in a peculiar manner, whereby the bolt is prevented from being moved till the stop is moved free from it, and the lock thereby rendered extremely difficult to pick."

Claim.—"The bar, with projection attached, in combination with the slide fitted within the slotted chamber, the above parts being arranged and used in connexion with the bolt."

201. For an *Improvement in Sleeve Buttons;* John P. Derby, Boston, Mass.

Claim.—"The lever, which is used by increasing the distance between the joint and the face plate by the means of a post, so shaped that the arm can be raised and depressed, said arrangement allowing the fastener to be entirely operated from the face sides, in securing it to, and detaching it from, the wrist bands."

202. For an *Improved Bullet Mould;* Henry L. De Zeng, Geneva, New York.

Claim.—"The movable cam-jaw, in combination with the cutting bar, whereby the movable jaw is held to the stationary jaw while the bullet is being cast, by forcing the handles apart, and on pressing the handles together the projection from the bullet is first cut off, and then the movable jaw is thrown back to discharge the bullet."

203. For an *Improved Rotary Shingle Machine;* Edwin Edwards, Oneida Lake, N.Y.

"This invention relates to an improvement in that class of machines for cutting shingles, in which cutters are attached to, or secured in, a rotating wheel."

Claim.—"The employment or use of the adjustable annular gauges, formed each of two parts and applied to the wheel."

204. For an *Improvement in Sewing Machines;* James E. A. Gibbs, Mill Point, Va.

Claim.—"Making a series of lock stitches with a double hook reciprocating the motion of a single revolution or part of such revolution. Also, in combination with a sewing machine, the hollow thread case of a spherical oval, or any other similar form, for containing a ball of thread having no fixed axis of revolution. Also, attaching to the globular thread case a plate, or its equivalent, furnished with two hooks, which are placed symmetrically, and combining the whole with any suitable mechanism that will impart thereto a reciprocating motion of a single revolution or part of such revolution, when the axis of revolution is fixed."

205. For an *Improved Machine for Creasing Plates for Railway Car Springs;* Perry G. Gardiner, City of New York.

Claim.—"The use of the V shaped roller and flat faced roller for creasing its plates, when operating in connexion with the carriage, the plate, and guide or stop plate."

206. For an *Improved Machine for Disengaging Railway Car Springs from Mandrels;* Perry G. Gardiner, City of New York.

Claim.—"The peculiar construction of the disengaging tool, and the manner of constructing the platform, when operating in connexion with spindle for detaching the coil."

207. For an *Improved Machine for Manufacturing Shoe Lasts;* Alanson and Wm. P. Haskell, North Brookfield, Massachusetts.

Claim.—"1st, The use of the concave head in connexion with the adjustable guides and rest. 2d, So constructing and hanging the bent lever, or its equivalent, as to allow the same pattern to be used for the different sizes, the position of the pattern governing the size. 3d, The combination of the lever, plate, and cutter head."

208. For an *Improved Composition for Floor Cloths;* J. W. Harman, Brooklyn, N. Y.

Claim.—"The use of this compound, or the application of the same, to the making and manufacturing of floor cloth carpets."

209. For an *Improved Steam Carriage;* John S. Hall, Pittsburgh, Pennsylvania.

Claim.—"1st, So combining and arranging the driving machinery and body of the carriage, with the wheels and axles, that the latter may be both swiveled, moved, or adjusted in any and all directions, without in the least changing the relation of the parts, or otherwise affecting the said driving machinery or body of the carriage. 2d, The stationary universal driving bearings or boxes, or their equivalents, whereby the axles and wheels may be readily rotated or driven in all their variable relative positions, with the driving machinery and body of the carriage. 3d, The double ratchet wheel, in combination with the pawls and spiral spring."

210. For an *Improved Hinge;* R. Hart, Marietta, Ohio.

"The nature of my invention consists in the employment of movable arms or levers, attached to one portion of the hinge or apparatus, and arranged to operate on flat and inclined planes or surfaces on the other portion of the hinge or apparatus, and thereby cause the gate or door to open and close."

Claim.—"The employment of the arms or levers. Also, in combination with the movable arms or lever, the lever constructed and arranged with a shifting pawl."

211. For an *Improvement in Corn Harvesters;* Abram Heulings, Philadelphia, Pa.

Claim.—"The combination of the tilting platform, the gates, curved arms, and swinging links, with the rock shaft, and its operating lever and rod, when said parts are arranged for joint operation."

212. For an *Improvement in Dry Gas Metres;* Hyam Jacob Hyams, Russia; patented in England, Feb. 16, 1856.

"My invention relates to that description of gas metres commonly called dry gas metres, and in which one side of the measuring compartments is formed by means of a movable or flexible diaphragm."

Claim.—"The connecting together the rigid parts of the movable diaphragms, in order that they may act together. Also, the construction and arrangement of the rotating circular valve."

213. For an *Improved Machine for Cutting Slots in Clothes Pins;* John Humphrey, Keene, New Hampshire.

Claim.—"A holder, so constructed that the pins may be received into a groove or chamber behind the part in which they are secured for the action of the saw, and then driven forward by a driving rod, or its equivalent, to the proper position for the cutting of the slots, the same being stationary or having a reciprocating motion. Also, in combination with the holder, the saw, the inclined spout, and the dog, or their equivalents."

214. For an *Improvement in Machines for Husking Corn;* Abraham R. Hurst, New Cumberland, Pennsylvania.

Claim.—"The employment or use of the sliding jaws or plates, lever, and plate or disk, the jaws or plates placed or fitted on the bed piece or platform, the above parts being arranged and used in connexion with the knife or cutter."

215. For an *Improvement in Carriage Tops;* R. S. Jennings, Waterbury, Conn.

Claim.—"The employment of a transverse hinge joint on each of the bows, at the centre of their top or horizontal portion, in combination with staples and two pair of bars, which are pivoted at one end to the front bows, and at the other end are each provided with a slot, and furnished with a hook."

216. For an *Improvement in Bee Hives;* Albert Kelsey, Westport, Missouri.

Claim.—"In combination with the double chambers of sash frames, the two walls with communicating passages through them, when said walls or partitions are so arranged that a slide or cut-off can be introduced between them, for the purpose of an entire separation."

217. For an *Improvement in Machines for Making Paste-board;* Louis Koch, City of New York.

Claim.—"1st, The arrangement of the roller, in connexion with the arm and projection or screw, for the purpose of operating the lever by which the slide is held fast or set at liberty when the board has obtained the required thickness, together with the arrangement of regulating by means of said screw, the required thickness of the paste-board. 2d, The movable slide, or its equivalent, constructed and operated for the purpose of cutting or tearing and lifting the paste-board, which was formed on the roller, from said roller, after the same has obtained the required thickness. 3d, The arrangement of the movable frame, with leather, or its equivalent, attached, for the purpose of stripping off the cut paste-board from the end of the slide."

218. For an *Improvement in Prairie Ploughs;* Jesse Frye, Springfield, Illinois.

Claim.—"1st, Supporting the after end of the plough beam upon a vertical journal, at the left hand end of the axle, when the bearings at the opposite end of said axle are so arranged that the position thereof may be varied and adjusted. 2d, Arranging the bearings of the rollers in such a manner that their positions may be varied and adjusted. 3d, In combination with the mould board composed principally of the series of adjustable rollers. Also, the adjustable triangular plate, for the purpose of making the whole conform to the position in which the furrow slice is to be laid or turned."

219. For an *Improvement in Machinery for Pressing Water out of Paste-board;* Louis Koch, City of New York.

Claim.—"The combination of the pressing-rollers, in connexion with the roller, arranged with endless felts in such a manner that the board shall be made to pass between the pressing rollers, between two thicknesses of felting to allow the water contained in the board to be pressed out of the same without injuring the board, during the pressing process."

220. For an *Improvement in Seed Planters;* George A. Meacham, City of New York.

Claim.—"1st, The box provided with the elastic side, and the head, or its equivalent, for the purpose of distributing or measuring the seed. 2d, The 'planter,' attached to the foot of the operator, and formed of the boards connected by the elastic straps, the boards having the plates attached to them and the under side of the board, the plate attached, the whole being arranged for the purpose of planting or forcing the seed into the soil by the pressure of the foot."

221. For an *Improvement in Preparing Yarn for Dyeing and Scouring;* Lucian E. Pratt, South Kingston, Rhode Island.

Claim.—"Making muffs of thread or yarn, to be dyed, or otherwise treated; the said improvement consisting in winding a series of threads, each separated from or at a distance from the other, in one helix band around a cylinder or drum, and so that the coils of each layer of such on the cylinder may cross those of the next layer."

222. For an *Improvement in Corn Planters;* John Miller, Bucyrus, Ohio.

Claim.—"The auxiliary compartment, having a slide acting simultaneously with the seed slide, for the purpose of designating the point of planting."

223. For an *Improved Mode of Securing Bits in their Stocks;* A. C. Moore, Wilmington, Vermont.

Claim.—"The application to bit stocks of a plain socket with a screw cap to hold the bit in place by a pressure upon the shoulder of the bit-head, thereby doing away with the necessity of fitting a bit before use, and gaining the advantage of a sure and firm fastening."

224. For an *Improved Method of Centering and holding Hubs while being Bored;* A. Moore, Honeyoye Falls, New York.

Claim.—"1st. The construction of the chuck, consisting of the combination of the ring and arms, said arms moving upon the fixed and movable points. 2d, The arrangement of the frames."

225. For an *Improvement in Harrows;* John E. Morgan, Deerfield, New York.

Claim.—"The providing for the vertical action between the two parts of the harrow, by means of the coupling formed by the use of the vertical elongated links, operating on the rod, or its equivalent."

226. For an *Improved Enema Syringe;* Charles H. Davidson, Charlestown, and Herman E. Davidson, Gloucester, Mass., Assignors to Charles H. Davidson, aforesaid.

Claim.—"The combination of the prolate of the spheroidal shaped elastic sack, with flexible tubes terminating in valve boxes containing valves, arranged for the purpose of eduction and ejection, when the sack tubes and valve boxes are in, or nearly in, the same axial line."

227. For an *Improvement in Steamboat Capstans;* John Schaffer, Manchester, Pa.

Claim.—"A capstan, the shaft of which rotates within the drums, which can be rotated separately or in conjunction with, and by or independently of, said shaft."

228. For an *Improved Automatic Lathe for Turning Irregular Forms;* William D. Sloan, City of New York.

Claim.—"The series of rotating and shifting mandrels for rotating the blocks to be turned, and shifting them from one operation to another, in combination with the series of traversing cutters, girded by patterns or moulds to determine the form to be produced, whereby a series of blocks are simultaneously subjected to the series of operations, and each in succession subjected to all the operations. Also, the mode of operation of the cutter, termed the finishing cutter, which said mode of operation consists in rolling the cutting edge along the surface of the block that is being turned, by reason of which a small portion only of the cutting edge is cutting at any one time, and immediately relieved and followed by another portion of the said cutting edge. Also, the sliding segment ring with its slots, in combination with the cutters and their appendages, for carrying the rangling cutters nearer to the axis of the blocks at each successive cutting action."

229. For an *Improvement in Steam Ploughs;* David B. Spencer, Parkersburg, Va.

Claim.—"The use of the single wheel at the rear end of the carriage as the sole driving wheel, and running in the bottom of the furrow turned by the plough. Also, hanging the two supporting wheels eccentrically on the same turning or rocking axle, so that whether the machine runs upon the level ground, or with one wheel higher or lower than the other, the frame and boiler shall still preserve its horizontal position."

230. For an *Improved Method of Constructing Bit Stocks;* Abel W. Streeter, Shelbourne Falls, Massachusetts.

"The nature of my invention consists in providing a bit stock with joints, for the purpose of folding in smaller compass for the convenience of packing in the mechanics' pocket or chest."

Claim.—"The construction of a bit stock in sections, said sections being connected by joints. Also, the mode of attaching the stock cap to the stock, by means of the box or tube, and cross pin, or its equivalent."

231. For an *Improvement in Stoves for Railway Cars;* George W. Thompson, Bordentown, New Jersey.

Claim.—"The balanced valve as hinged to the interior of the pipe, in combination with the lever, levers, their disks, and the perforations in the cap."

232. For an *Improvement in Shaping Engines;* Sylvanus J. Wetherell and Eustace P. Morgan, Biddeford, Maine.

Claim.—"To make the screw a stationary male screw, and the female screw (attached to the carriage, and made to work on the screw,) a rotary, and to combine with them and the gear (by which and the gear the shaft is rotated), the gears (the latter being made to rotate on the shaft, and to be fixed to the former as occasion may require, by a pin, or its equivalent), a rocker arm, and double pawl, (or mechanical equivalents therefor,) applied to the shaft, the whole being to enable a workman to control the operations of the machine as stated, without being obliged to go to the end of the frame, or leave his work, in order to adjust or change the feed motion of the cutting tool, whether it be planing either plain or cylindrical work."

233. For an *Improved Raking Apparatus for Harvesters;* Jesse Urmy, Wilmington, Delaware.

Claim.—"Operating the rear end of the rake by means of a crank, when said crank moves with the pin that operates the rake bar, in combination with the connecting rod and adjusting holes."

234. For an *Improvement in Baby Jumpers;* Marion J. Wellman, City of New York.

Claim.—"The combination of the cross and corner springs, attached to separate points of suspension, at a distance from the centre and beyond the centre of gravity, with an infant's seat."

235. For an *Improved Method of Feathering the Sails or Vanes of Wind-Mills;* J. C. and F. G. Wilson, Cedar Hill, Texas.

"The nature of our invention consists in giving the wings a means of bringing the edges of the wings to the wind, for the protection of the wheel during storms."

Claim.—"The combination of the traversing screw, having stops with the slide piece and rods leading to the wing."

236. For an *Improved Gunpowder Keg;* James Wilson, Charles Green, and Wm. Wilson, Brandywine, Delaware.

Claim.—"The making the sides or cylinder of corrugations, and bulge or swell, when employed with the extra ring and boss-head, for the purpose of greater strength, and more convenient handling."

237. For an *Improved Fluid Metre;* James Cochrane, City of New York.

Claim.—"In combination with a tilting measuring vessel, or its equivalent, enclosed within an air-tight vessel, a secondary air-tight vessel connected with the former. Also, combining with a measuring vessel, treated in, and combined with, an air chamber, an apparatus which shall from time to time introduce portions of the outer air into the interior of the air chamber."

238. For an *Improvement in Life Preserving Bedsteads and Sofas;* John T. Garlick, City of New York.

Claim.—"The air and water-tight bedstead, settee, or sofa."

239. For an *Improved Machine for Composing and Distributing Type;* William H. Houston, Belfast, Maine.

Claim.—"1st, The machine for composing types. 2d, The method of selecting the types from the cases, by means of the springs, or their equivalents, operating in connexion with the keys. 3d, The method of transferring the types to the stick by means of the plungers, or their substantial equivalents. 4th, Raising the rule, and throwing forward the line of type upon the galley, by any means substantially the equivalent thereof. 5th, The method of feeding forward the types in the cases by means of the slipping bands, rods, and cylinder, or their equivalents. 6th, The wheel, with its ratchet wheel, and the connexions, or their equivalents, whereby this wheel is caused to give motion to the shaft whenever any one of the keys is depressed. 7th, The method of connecting the crank with the pitman, by means of the spring. 8th, The distributing machine, constructed by means of which a column of type, when placed in the machine, is distributed automatically. 9th, The method of forwarding the types to the trial case, by means of the vibrating case."

240. For an *Improved Machine for Washing Gold;* Samuel S. Lewis, San Juan, Cal.

"The nature of the invention consists in constructing the riflle boxes with bars, forming an upper surface, over which the large debris or rock shall be carried by the stream of water employed, while the finer portions of soft ground on the bars, by attrition thereof with the magnetic sand and precious metal, shall be subjected to a sub or under current of water, while passing between the ribs of the aforesaid ribs."

Claim.—"Employment of riffles or bottoms, constructed so that an under current of water may be used between the ribs, in connexion with that flowing over the surface of the bars of the riffles."

241. For an *Improvement in the Manufacture of Paper Pulp;* Columbus F. Sturgis, Carlowville, Alabama.

Claim.—"The process of manufacturing paper pulp from the bark of the root and the bark of the stalk of the cotton plant."

242. For an *Improvement in the Manufacture of Paint Brushes;* James T. Steer, City of New York.

Claim.—"The use of the binding ferrule for the purpose of effecting the introduction of the bristles into the cap ferrule, the said cap ferrule being made in one piece with its cap and shank."

243. For an *Improved Gas Regulator;* Charles J. Halstead and John Cœyman, Assignors to Decker, Godine & Halstead, City of New York.

"The nature of our invention consists in attaching to the main or service pipe leading to the metre, our improved regulator, so combined as to preclude the possibility of an unavoidable waste of gas."

Claim.—"A gas regulator, to be located between the metre and main gas pipe, and composed of the perforated plate, having a flanch upon it provided with external and internal screw threads, and a plate similarly perforated and provided with a screw which runs into said internal screw thread on the plate, and adjustable therein by its stem, when said plates are combined with a single valve and adjustable spring, and the whole arranged within the shell."

244. For an *Improved Machine for Printing from Engraved Plates:* Linus Stewart and John McClelland, Assignors to David and J. McClelland, Washington, D. C.

Claim.—"Heating the plate from which the impression is to be taken, by means of a hollow bed plate into which steam is admitted. Also, the cleaning of the plate by means of a horizontally revolving cleaning apparatus, in which a clean surface is constantly brought into contact with the plate at every revolution of the cleaner. Also, in combination with the fingers or nippers, the cam and spring, which alike hold them, whether opened or closed."

245. For an *Improved Form or Mould on which Wooden Slats, &c., are made into Baskets;* J. A. H. Ellis, Assignor to J. Woodbury, Trustee, &c., Springfield, Vt.

Claim.—"The basket mould, constructed of a block or former made with annular and top recesses, and provided with a shoulder ring, hoop catches, and the bottom clamping plate and screws, or equivalents therefor."

246. For an *Improved Machine for Cutting the Throats of Carpenters' Plane Stocks;* Henry S. Dewey, Assignor to self and Levi W. Newton, Bethel, Vermont.

Claim.—"The combination of the shaft path cutter, the plane iron and wedge throat cutter, the movable carriage, and the adjustable bearer, by which the inclinations of the ends of the throats may be obtained."

247. For an *Improvement in Making Table Knives;* Conrad Poppenhusen and C. F. E. Simou, Assignors to Conrad Poppenhusen, College Point, New York.

Claim.—"The mode of procedure by which we effect the union of the steel blade with the cast balanced nut, whether of malleable or ordinary cast iron, by preparing the rear end of the steel blades with cleansed parallel sides, fitting a groove with parallel sides in the cast balance nut, preparing the surfaces with borax, or other equivalent flux, and then welding the same by heat and pressure."

ADDITIONAL IMPROVEMENT.

1. For an *Improvement in Fire Arms;* Frederick D. Newbury, Assignor to Richard Varick De Witt, Jr., Albany, New York; patented August 12, 1856; additional dated March 31, 1857.

Claim.—"The employment of a permanent cone, combined with a ring lying between it and the chamber of the barrel, with a disk fitted upon the ring—the ring being divided on one of its sides by a cut, into which is fitted a pin or wedge—the cone or wedge being so shaped in reference to the ring, as to expand it against the charge chamber upon the least re-action of the charge when fired."

RE-ISSUES FOR MARCH, 1857.

1. For an *Improvement in Breech Loading Fire Arms;* B. F. Joslyn, Worcester, Mass.; patented Aug. 28, 1855; re-issued March 13, 1857.

Claim.—"A cone headed pin, with two or more expanding rings—and in making the exterior of a breech pin cone-shaped—also, combining the same with the radial or hinge breech."

2. For an *Improvement in Carding Engines;* A. D. Shattuck, Grafton, Massachusetts; patented Sept. 23, 1856; re-issued March 10, 1857.

Claim.—"1st, The application to carding engines of two or more variable cylinders, arranged and operated for the purpose of preventing the filling up of the main cylinder. 2d, The use of a doffer, in combination with strippers or cleaners, arranged and operating for the purpose of preventing the filling up of the main cylinder, and producing an uniform sheet."

3. For an *Improvement in Saw-Mills;* Wm. P. Wood and Samuel De Vaughan, Washington, D. C., Assignees of George W. Hedge, Brooklyn, N. Y., Assignee of Lemuel Hedge, City of New York; patented May 8, 1849; re-issued March 10, 1857.

Claim.—"The means to regulate the deflection of the saw blade when at work—that is to say, the application of the feed rollers to the back of the saw blade. Also, the driving power to the lower pulley, when the saw is designed to work in its downward motion."

4. For an *Improvement in Looms for Weaving Pile Fabrics;* Erastus B. Bigelow, Boston, Mass.; patented Dec. 18, 1855; re-issued March 17, 1857.

Claim.—"Successively drawing the pile wires from the cloth by a latch or hook. Also, constructing and operating said latch hook, so that after drawing said pile wires from the cloth, it successively delivers them to a carrier, or other apparatus, which completes their movement. Also, in combination with a latch or hook for drawing the pile wires from the cloth, a carrier or apparatus, to successively receive said pile wires from said latch or hook, and transfer them to the fell of the cloth. Also, the method of inserting the pile wires into the upper shed of the warps, while the shuttle is pressed through the lower shed."

5. For an *Improvement in Running Gear of Carriages;* Gustavus L. Haussknecht, New Haven, Connecticut; patented January 13, 1852; re-issued March 17, 1857.

Claim.—" 1st, The combination and arrangement of the pivot in the rear of the fore axle, and the segments, with the perch and head block, or perch cross-bar of carriages having perches, or the equivalents thereto, for the purpose of enabling carriages to turn in a shorter space than by the common mode of coupling with perfect safety. 2d, The additional set of segments, or their equivalents, the pivot placed perpendicularly above the lower turning point, to be employed where the springs are fastened to an axle, and move with the same."

6. For an *Improvement in the Machine for Sawing off Logs;* Cornelia Waterman, Brooklyn, New York, Administratrix of Stephen Waterman, deceased, Greenwich, Connecticut, Assignee of Isaac D. Russell, City of New York; patented May 19, 1843; re-issued March 17, 1857.

Claim.—" Revolving a log or block while being sawed, in order that the pieces sawed off may be of uniform thickness on all sides, and the mechanism, or its equivalent, for raising and lowering said block, that it may be sawed into pieces of any desired thickness, without being removed from the machine, said block being centered but once in sawing up the entire log."

7. For an *Improvement in Sugar Works;* Norbert Rillieux, City of New York; patented Aug. 26, 1843; re-issue dated March 17, 1857.

Claim.—" 1st, The employment of a vacuum pan or pans, in combination with an evaporating pan or pans, or boiler, in which the saccharine juice or other fluid is evaporated under a pressure lower, equal to, or greater than, the atmosphere, which last mentioned pan or pans, or boiler, prepares the saccharine juice, &c., from the vacuum pan or pans, and at the same time supplies the necessary vapor from the saccharine juice, &c., to complete the evaporation or concentration of syrup, &c., in the vacuum pan or pans. 2d, The employment of a weighted throttle or other regulating valve, in the main steam pipe."

8. For an *Improvement in the Machine for Forming the Web for Cloth of Wool, Hair, or other suitable substances, without Spinning or Weaving;* The Union Manufacturing Company, Assignees of John Arnold and George G. Bishop, Norwalk, Connecticut; patented October 20, 1836; extended by Commissioner from October 20, 1850; extended by Act of Congress, March 28, 1854; re-issued March 17, 1857.

Claim.—" The mode of operation by means of which the slivers of the weft fibres are kept properly distended, until their entire surface is in contact with the surface of the sliver of warp fibres."

9. For an *Improvement in Harrows;* Sidney S. Hogle, York, Ohio.

Claim.—" Causing the forward movement of a pivoted horizontal harrow to impart a rotary motion thereto, by means of the auxiliary action of a weighted roller, or its equivalent, upon one side or the other of said harrow."

10. For an *Improvement in Vault Covers;* John B. Cornell, City of New York; patented Feb. 19, 1856; re-issued March 24, 1857.

Claim.—" Grooving or channeling the upper surfaces of the metallic portions of illuminating covers; but this I only claim when the glasses in said grooved covers are so arranged as to bring their upper surfaces flush with, or a little above, the upper surfaces of said covers."

11. For an *Improvement in Setting Mineral Teeth;* John Allen, City of New York; patented Dec. 23, 1851; re-issued March 21, 1857.

Claim.—" A new and useful mode and improvement in setting mineral teeth on metallic plates, by means of a fusible mineral compound or cement, which is used to fill up the interstices between and around the base of the teeth and upon the plate, of which a continuous artificial gum is formed without seam or crevice."

12. For an *Improvement in Window Curtain Fixtures;* Silas S. Putnam, Boston, Mass.; patented April 15, 1851; re-issued March 31, 1857.

Claim.—" Attaching the curtain to its roll by a piece or strip, which fits into a groove in the roll, and is secured thereto by caps at the ends."

13. For an *Improvement in Planing Machines;* James A. Woodbury, Winchester, Mass.; patented July 7, 1854; re-issued March 31, 1857.

Claim.—" 1st, The combination of the rotary disk cutter with the pressers and bed. 2d, The combination of the Bramah wheel, so called, with the rotary disk cutter and its accessories, for the purpose of planing. 3d, The method of planing with a continuous drawing cut."

14. For an *Improvement in Platform Scales;* Thaddeus Fairbanks, St. Johnsbury, Vermont; patented January 13, 1857; re-issued March 31, 1857.

Claim.—"My improved arrangement and combination of four bearing multiplying levers, a multiplying lever, and a lever, made so as to act at the same time as an equalizing and a multiplying lever—the whole being applied to a steelyard weighing lever. Also, arranging the suspension bridge so that its arched standards shall extend upwards by the sides of the platform, and between it and the sides of the pit, in combination with arranging the transverse levers and their bearings below the platform—the same affording the necessary room for the vertical play of the longitudinal levers, while it secures an advantage as regards the depth of the pit."

15. For an *Improvement in Furnace for Burning Wet Fuel;* Moses Thompson, City of New York; patented April 10, 1855; re-issued March 31, 1857.

Claim.—"Using green bagasse, wet tan, wet saw dust, and other wet carbonaceous or vegetable substances, as fuel for the production of intense heat, by mingling the gases issuing from a highly heated mass thereof, with those arising from carbonaceous combination, by the intervention of a flue or chamber, with which the chamber or chambers containing the fire and charge of wet substances communicate, and in which said gases meet, mingle, and consume each other on their way to the apparatus to be heated, and to the stack. Also, the combination, for the purposes of a high degree of heat, of bagasse, refuse tan, saw-dust, and other wet refuse substances, or very wet and green wood, by the employment of a series of fire chambers, arranged in any manner to communicate with one common flue or mixing chamber, when any number of said chambers are nearly closed to the admission of air when first charged, whilst the remaining chamber or chambers is in full communication with the mixing chamber, and has a proper supply of air admitted, and the ash-pit of each chamber in its turn is nearly closed, and then opened, and has air admitted, whereby the heat required is rendered continuous, and comparatively uniform, while the fuel in some of the chambers is being heated and decomposed, and its gases sent forward to the mixing chamber to any desirable degree."

DESIGNS FOR MARCH, 1857.

1. For *Cooking Stoves;* Allen Comstock, Quincy, Illinois; dated March 10, 1857.

Claim.—"The design and configuration of the several parts of the stove, in combination with the projecting pilasters, mouldings, and ornaments in relief."

2. For *Stove Doors;* M. C. Burleigh, Great Falls, N. H.; dated March 10, 1857.

Claim.—"The central ornament within the annular bead, the angular corrugations on the face or panel of the door, and the beads around the edges of the panel, and the beveled or inclined edges of the door, having the ovolo beads upon them and the obtuse quirks."

3. For *Floor Oil Cloths;* James Hutchison, Assignor to Jonathan E. Whipple and Stephen E. Haskell, Lansingburgh, New York; dated March 10, 1857.

Claim.—"The arrangement of ornamental figures."

4. For *Soda Water Apparatus;* Jos. Bernhard, Assignor to self, Joseph Hindermeyer, and Louis Gansz, Philadelphia, Penna.

Claim.—"The design and configuration of the parts of the self-cooling draft apparatus."

5. For *Radiator Stoves;* N. S. Vedder, Troy, N. Y., Assignor to Galbraith & Cassell, Jacksonville, Illinois.

Claim—"The ornamental design and configuration of the end plate and its fire door, hearth, and feet, of the illuminated side door with its frame, and of the pot hole frame with its cover."

6. For *Cooking Stoves;* N. S. Vedder, Troy, Assignor to John S. and Merritt Peckham, Utica, New York.

Claim.—"The general design."

7. For *Legs and Posts of Bedsteads;* Wm. Maurer, City of N. Y.; dated March 31, 1857.

Claim.—"The posts, with scroll bars and vines, the panels with ornaments, and the legs having the leaf-scrolls, leaf-edging, and the tulip and fluted ornaments."

MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

Notes on the Performance of the Steamer William Jenkins.

The steamers *William Jenkins* and *Joseph Whitney*, constitute a line between Baltimore and Boston, principally for freight, and have been running most successfully since they were placed on the route.

The *Jenkins* was built in Baltimore by J. A Robb, engine and boilers by Messrs. Murray & Hazlehurst, "Vulcan Works."

The *Whitney* in New York by John Englis, engine and boiler by the "Neptune Iron Works." Full particulars of these two ships will be found in the *Journal Franklin Institute* of February and March, 1855, but, for a more convenient reference, I have inserted *here* a few of the more important dimensions.

William Jenkins.	feet.
Length on deck,	205
Breadth of beam,	31
Depth of hold,	9
Immersed sectional area at 13·5 feet mean draft,	390
Tonnage C. H. M.,	1000.
Motive Power.	
One top beam engine.	
Diameter of cylinder,	56½ ins.
Stroke of piston,	9 ft.
Diameter of water wheel,	26 "
Length of blades,	8 ft. 6 ins.
Depth of "	22 "
Sickels' cut-off adjustable.	

J. Whitney.	feet.
Length on deck,	200
Breadth of beam,	33
Depth of hold,	9
Immersed sectional area at 13·5 feet mean draft,	390·5
Tonnage C. H. M.,	1000.
Motive Power.	
One top beam engine.	
Diameter of cylinder,	52 ins.
Stroke of piston,	11 ft.
Diameter of water wheel,	29 "
Length of blades,	7 ft. 6 ins.
Depth of "	18 ins.
Stevens's cut-off fixed.	

Through the kindness of Mr. A. Senifleben, I have been furnished with copies of the *William Jenkins's* steam logs, for a trip from Baltimore to Boston and back.

STEAM LOG.—*Going to Boston, December* 6, 1856.

Date, &c., Dec. 6, 1856.	Average Steam.	Cut-off.	Vacuum.	Throttle valve.	Register.	Revolutions per hour.	Average revolutions per minute.	Saturation.	Hot-well.	Average coal per hour.
P. M.										
1	22	½	25	Full.	182					
2	22	"	"	"	912	730	12·1		115°	1239·6
3	22	"	"	"	1648	736	12·2		"	"
4	22	"	"	"	2380	732	12·2		"	"
5	22	"	"	"	3112	732	12·2		"	"
6	22	"	"	"	3844	732	12·2		"	"
7	22	"	"	"	4575	731	12·1		"	"
8	23	"	"	"	5347	772	12·8		"	"
9	22	"	"	"	6360	751	12·5		"	"
10	22	"	"	"	6816	748	12·4		"	"
11	22	"	"	"	7597	751	12·5		"	"
12	22	"	"	"	8353	756	12·6		"	"
A. M.	22·08	51					12·3			1239·6

STEAM LOG.—*Going to Boston, December* 7, 1856.

Date, &c., Dec. 7, 1856.	Average Steam.	Cut-off.	Vacuum.	Throttle valve.	Register.	Revolutions per hour.	Average Revolutions per minute.	Saturation		Hot-well.	Average coal per hour.
A. M.											
1	22	½	25	Full.	9111	758	12·6			115°	1239·6
2	23	“	“	“	9888	777	12·95			“	“
3	22	“	“	“	10645	754	12·57			“	“
4	22	“	“	“	11394	748	12·47			“	“
5	22	“	“	“	12134	740	12·3			“	“
6	22	“	“	“	12869	735	12·2	1⅜	1½	“	“
7	22	“	“	“	13570	701	11·6	“	“	“	“
8	22	“	“	“	14220	650	10·8	“	“	“	“
9	22	“	“	“	14856	636	10·6	“	“	“	“
10	22	“	“	“	15480	634	10·5	1⅝	1¾	“	“
11	22	“	“	“	10110	630	10·5	“	“	“	“
12	22	“	“	“	16798	688	11·1	“	“	“	“
P. M.											
1	22	“	“	“	17516	718	11·9	1¾	“	“	“
2	22	“	“	“	18236	720	12·	“	“	“	“
3	22	“	“	“	18968	732	12·2	“	“	“	“
4	22	“	“	“	19716	748	12·4	“	“	“	“
5	22	“	“	“	20446	730	12·1	“	“	“	“
6	22	“	“	“	21191	745	12·4	“	“	“	“
7	22	“	“	“	21953	762	12·7	“	“	“	“
8	22	“	“	“	22730	777	12·9	“	“	“	“
9	22	“	“	“	23446	716	11·9	“	“	“	“
10	22	“	“	“	24137	691	11·5	“	“	“	“
11	22	“	“	“	24795	658	10·9	“	“	“	“
12	22	“	“	“	25405	610	10·1	“	“	“	“
	22·04	54					11·79				1239·6

STEAM LOG.—*Going to Boston, December* 8, 1856.

Date, &c., Dec. 8, 1856.	Average Steam.	Cut-off.	Vacuum.	Throttle valve.	Register.	Revolutions per hour.	Average revolutions per minute.	Saturation		Hot-well.	Average coal per hour.
A. M.											
1	22	½	25	Full.	26022	617	10·28	1¾	1¾	115°	1239·6
2	22	“	“	“	26650	623	10·7	“	“	“	“
3	22	“	“	“	27265	620	10·6	“	“	“	“
4	23	“	“	“	27930	665	11·	“	“	“	“
5	23	“	“	“	28620	690	11·5	“	“	“	“
6	23	“	“	“	29300	680	11·3	“	“	“	“
7	21	“	“	“	29923	620	10·3	“	“	“	“
8	23	“	“	“	30643	720	12·	“	“	“	“
9	21	“	“	“	31304	661	11·	“	“	“	“
10	22	“	“	“	31984	690	11·5	“	“	“	“
11	22	“	“	“	32684	690	11·5	“	“	“	“
12	22	“	“	“	33377	693	11·5	“	“	“	“
P. M.											
1	19	“	“	“	34069	692	11·5	“	“	“	“
2	19	“	“	“	34777	708	11·8	“	“	“	“
3	21	“	“	“	35510	733	12·2	“	“	“	“
4	21	“	“	“	36237	727	12·1	“	“	“	“
5	20	“	“	“	36949	712	11·8	“	“	“	“
6	21	“	“	“	37672	723	12.	“	“	“	“
7	22	“	“	“	38424	752	12·5	“	“	“	“
8	22	“	“	“	39275	851	14·1	“	“	“	“
9	19	“	“	“	40068	793	13·2	“	“	“	“
10	22	“	“	“	40907	834	13·9	“	“	“	“
11	22	“	“	“	41752	846	14·1	“	“	“	“
12	20	“	“	“	42564	811	13·5	“	“	“	“
	21·04	54					11·91				1239·6

Steam Log.—*Going to Boston, December* 9, 1856.

Date &c., Dec. 9, 1856.	Average Steam.	Cut-off.	Vacuum.	Throttle valve.	Register.	Revolutions per 4 hours.	Average revolutions per minute.	Saturation		Hot-well.	Average coal per hour.
A. M.											
1	21	½	25	Full.	43385	821	13·6	1¾	1¾	115°	1239·6
2	22	“	“	“	44230	845	14·	“	“	“	“
3	21	“	“	“	45056	826	13·7	“	“	“	“
4	22	“	“	“	46891	835	13·8	“	“	“	“
5	22	“	“	“	46724	832	13·8	“	“	“	“
6	22	“	“	“	47550	832	13·8	“	“	“	“
7	22	“	“	“	48393	837	13·9	“	“	“	“
8	23	“	“	“	49251	858	14·3	“	“	“	“
9	22	“	“	“	50059	808	13·4	“	“	“	“
10	23	“	“	“	50803	744	12·4	“	“	“	“
11	23	“	“	“	51524	721	12·	“	“	“	“
12	24	“	“	“	52217	723	12·08	“	“	“	“
P. M.											
1	24	“	“	“	52920	703	11·7	“	“	“	“
2	24	“	“	“	53650	700	11·6	“	“	“	“
3	24	“	“	“	54354	704	11·7	“	“	“	“
4	24	“	“	“	55070	716	11·9	“	“	“	“
5	24	“	“	“	55778	705	11·7	“	“	“	“
6	24	“	“	“	56907	711	11·7	“	“	“	“
7	24	“	“	“	57219	704	11·9	“	“	“	“
8	23	“	“	“	57911	699	11·6	“	“	“	“
9	22·0	54									
10											1239·6
11											
12											

Remarks.—December 6th, 1856, P. M. At 12 h. 44′ got underway from the dock at Baltimore, at one hour abreast of the “Lazaretto.” Register 188 revolutions. At two hours set foresail and foretopsails, wind light and fair, at 2h. 2′ North Point light abeam. Register 956 R. At 3h. 50′ set main spencer, wind W. N. W., weather fair and a fine breeze. At 11h. 55′ passed Smith's Point light boat; register 8291 revolutions. At midnight took in main spencer.

December 7th. At 3h. 12′ passed Wolf's Trap light boat; register 10,792 revolutions. At 6h. 10′ took in all sails. At 6h. 49′ passed out by Cape Henry; register 13,400 R.; light airs, smooth sea. At 1h 45′ set jib and main spencer. At 2h. 15′ set foresail. At 3h. 5′ abreast of Chincotigue; register 19,596 R.; last part of this 24 hours some sea on and increasing.

December 8th. During first part of this 24 hours sea moderating, wind fresh from W. N. W. At 7h. 25′ set topsails and foresails. At 11 h. 6′ abreast of Montauk Point; register 41,836 R., having made from Cape Henry to this Point 28,436 R.; latter part of this 24 hours sea moderate, light breezes.

December 9th. At 12h. 30′, A. M., Block Island abeam: register 43,066 R. At 4h. 12′, P. M., Gay Head light abeam; register 46,055 R. At 4h. 54′ took in forespencer. At 6h. 41′ passed Cross Rip light boat; register 48,266 R. At 8h. 45′ took in all sails. At 8h. 45′ passed Pollock's Rip light boat; register 49,987 R.; strong head wind and tide. At 8h. 7′ come to at the wharf at Boston, having made during the run, 57,995 revolutions, and was 79·5 hours running time.

From the above log, the following averages were taken, and will be used as the basis of an investigation of the performance of that ship for the run to Boston.

Average coal consumed per hour,	1239·6 lbs.
" steam per gauge,	22·105 ins.
" cut-off,	54· ins.
" revolutions per minute,	12·18
" vacuum,	25 ins.
" temperature hot-well,	115°
" temperature feed-water, (heater,)	139°
" density of boiler water,	$1\frac{3}{4}$

The running distance from Baltimore to Boston is 666 nautical miles, and the total number of revolutions made was 57,995, time required to make the run $79\frac{1}{2}$ hours.

Boilers.—Two in number, 14 feet long, 11 feet 2 inches wide, and 13 feet high, each boiler has two furnaces, 6 feet long, 5 feet wide, two doors to a furnace.

The heated gases pass from each furnace to the back connexion, through two large flues, 21 inches diameter, 5 feet 7 inches long, and from thence through horizontal return *tubes* 4 inches external diameter, 10 feet long, (106 in each boiler,) to the smoke pipe.

Diameter of smoke pipe,	66 inches.
Height of smoke pipe from grate bars,	46 feet.
Average distance of grate bars from furnace crowns,	36 inches.
Grate surface,	120 sq. ft.
Natural draft,	(excellent.)
Fuel,	bituminous coal.
Total fire surface,	———

When burning 1239·6 pounds of coal per hour, cutting off at 54 ins., making 12·18 revolutions per minute, with an average steam pressure of 22·105 lbs. per square inch, the boilers gave an evaporation of $8\frac{79}{100}$ pounds of water per pound of coal. Consuming per hour per square foot of grate surface 10·3 lbs.

The saturation was kept at $1\frac{3}{4}$, and the loss by blowing to maintain this point, was $15\frac{47}{100}$ per cent.

A heater or reservoir was fitted in the upper part of the steam chimney, and so arranged that the feed-water from the hot-well should circulate freely around it before entering the boiler, by which its temperature was increased from 24° to 30°; taking it at 24° as given in the log, and we have as the economic result, a gain of $2\frac{48}{100}$ per cent. in amount of heat, or $\frac{33}{100}$ tons of coal per diem.*

The space between the valves, and in the cylinder nozzles, added to the clearance, make 6·22 cubic feet to be filled with steam at each end of the cylinder before the commencement of the stroke, and although this steam is not a total loss, yet it is an element affecting the boilers in the abstract, and it is thought proper to consider it under this head.

In the case of the "*Jenkins*," $6\frac{22}{100}$ cubic feet is equivalent to $4\frac{28}{100}$ inches of the cylinder length, and taking 27·52 lbs. per square inch as the mean effective pressure acting on the piston for the full length of the stroke, viz: 108 inches, the total power developed by the engine, may be represented as follows, $27 \cdot 52 \times 108 = 2972 \cdot 16$.

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* This heater or reservoir was not in the original design of the machinery, but was adopted at the request of the engineer in charge, after the ship had been running for several months. I am of the opinion that a heater placed in such a position and prove very effective, would be at least, presumptive evidence of defective design in the boiler somewhere.

The effective pressure at the *end* of the stroke was 14·7 lbs., acting through $4\frac{28}{100}$ inches$=62 \cdot 916$, which is 2·12 per cent. nearly of 2972·16; therefore, the loss of power sustained by filling the vacuities before the stroke commences, may be represented proportionally as follows, viz: $14 \cdot 7 \times 4 \cdot 28 = 62 \cdot 916$, and 62·916 being 2·12 per cent. of 2972·16, the total power, a loss of 2·12 per cent. or $9\frac{71}{100}$ horse power is the result.

Performance of Engine.

The mean performance for the run of 79·5 hours was as follows, $\frac{2507 \cdot 1 \times 27 \cdot 52 \times 219 \cdot 24}{33{,}000} = 458 \cdot 4$ H. P. developed. The distribution being as follows:

Oblique action and slip,	26·	per cent. or	119·184	H. P.
Friction of engine,	7·	"	32·08	"
" load,	4·5	"	20·628	"
Power required to work air-pump,	3·6	"	16·55	"
Leaving to be utilized in propelling the ship,	58 9	"	269·997	"
	100·0		458·439	

Proportion of immersed sectional area to effective horse power, 1·4 : 1.

On the return trip, viz: from Boston to Baltimore, different results were obtained, as will be seen by inspection of the following log, and the deductions made therefrom:

STEAM LOG.—*Returning to Baltimore, December* 27, 1856.

Date, &c., Dec. 27, 1856.	Average steam.	Cut-off.	Vacuum.	Throttle valve.	Register.	Revolutions per hour.	Average revolutions per minute.	Saturation.	Hot-well.	Average coal per hour.
P. M.										
1										
2										
3										
4										
5	15	41 in	25	$\frac{2}{3}$	526				115°	
6	17	"	"	Full.	1585	1057	17·6		"	1652
7	17	"	"	"	2639	1054	17·5		"	"
8	17	"	"	"	3674	1035	17·2		"	"
9	19	"	"	"	4753	1079	17·98		"	"
10	18	"	"	"	5794	1041	17·3		"	"
11	19	"	"	"	6872	1078	17·6		"	"
12	19	"	"	"	7939	1067	17·7		"	"
	17·6	11 in					17·55			1652

STEAM LOG.—*Returning to Baltimore, December* 28, 1856.

Date, &c., Dec. 28, 1856.	Average steam.	Cut-off.	Vacuum.	Throttle valve.	Register.	Revolutions per hour.	Average Revolutions per minute.	Saturation.		Hot-well.	Average coal per hour
A. M.											
1	19	41 ins.	25	Full.	8977	1036	17·26			115°	1652
2	20	do	do	do	10017	1030	17·16			do	do
3	20	do	do	do	11036	1019	16·98			do	do
4	21	do	do	do	12080	1044	17·4			do	do
5	21	do	do	do	13132	1052	17·5			do	do
6	21	do	do	do	14180	1048	17·4			do	do
7	21	do	do	do	15212	1032	17·16			do	do
8	21	do	do	do	16292	1080	18·			do	do
9	19	do	do	do	17351	1059	17·6	1⅝	1¾	do	do
10	21	do	do	do	18471	1120	18·6	do	do	do	do
11	21	do	do	do	19574	1103	18·3	do	do	do	do
12	21	do	do	do	20678	1104	18·3	do	do	do	do
P. M.											
1	19	do	do	do	21735	1051	17·5	1¾	do	do	do
2	19	do	do	do	22828	1093	18·2	do	do	do	do
3	21	do	do	do	23961	1133	18·88	do	do	do	do
4	20	do	do	do	25087	1226	20·4	do	do	do	do
5	20	do	do	do	26194	1107	18·45	do	do	do	do
6	20	do	do	do	27331	1137	18·9	do	do	do	do
7	20	do	do	do	28476	1145	19·	do	do	do	do
8	20	do	do	do	29620	1144	19.	do	do	do	do
9	20	do	do	do	30769	1149	19·1	do	do	do	do
10	20	do	do	do	31914	1145	19·	do	do	do	do
11	20	do	do	do	33039	1125	18·7	do	do	do	do
12	21	do	do	do	34194	1155	19·	do	do	do	do
	20·25	41					18·28				1652

STEAM LOG.—*Returning to Baltimore, December* 29, 1856.

Date, &c., Dec. 29, 1856.	Average steam.	Cut-off.	Vacuum.	Throttle valve.	Register.	Revolutions per hour.	Average revolutions per minute.	Saturation.		Hot-well.	Average coal per hour.
A. M.											
1	18	41 ins.	25	Full.	35271	1077	17·9	1¾	1¾	115°	1652
2	20	do	do	do	36412	1141	19·2	do	do	do	do
3	21	do	do	do	37566	1154	19·	do	do	do	do
4	20	do	do	do	38707	1141	17·5	do	do	do	do
5	18	do	do	do	39800	1053	19·1	do	do	do	do
6	20	do	do	do	40947	1147	19·2	do	do	do	do
7	20	do	do	do	42089	1142	18·8	do	do	do	do
8	21	do	do	do	43242	1153	19·7	do	do	do	do
9	20	do	do	do	44374	1132	17·9	do	do	do	do
10	22	do	do	do	45557	1183	19·7	do	do	do	do
11	22	do	do	do	46743	1186	19·7	do	do	do	do
12	22	do	do	do	47223	1180	19·6	do	do	do	do
P. M.											
1	19	42 ins.	do	do	49024	1101	18·3	do	do	do	do
2	21	do	do	do	50184	1160	19 3	do	do	do	do
3	21	do	do	do	51358	1174	19·5	do	do	do	do
4	20	do	do	do	52415	1157	19·2	do	do	do	do
5	20	do	do	do	53590	1175	19·5	do	do	do	do
6	21	do	do	do	54778	1188	19 8	do	do	do	do
7	20	do	do	do	55933	1155	19·2	do	do	do	do
8	20	do	do	do	57089	1156	19·2	1⅝	1¾	do	do
9	20	do	do	do	58233	1144	19·	do	do	do	do
10	21	do	do	do	59385	1152	19·2	do	do	do	do
11	22	do	do	do	60563	1178	19·6	1¼	1¾	do	do
12	21	44	do	do	61723	1161	19·3	do	do	do	do
		41·1/8					19·1				1652

STEAM LOG.—*Returning to Baltimore December* 30, 1856.

Date, &c., Dec. 30, 1856.	Average steam.	Cut-off.	Vacuum.	Throttle valve.	Register.	Revolutions per hour.	Average revolutions per minute.	Saturation.		Hot-well.	Average coal per hour.
A. M.											
1	19	44 ins.	25 ins.	Full.	62846	1113	18·5	$1\frac{1}{2}$	$1\frac{1}{2}$	115°	1652
2	20	"	"	"	64012	1166	19·4	"	"	"	"
3	20	"	"	"	65172	1160	19·3	"	"	"	"
4	20	"	"	"	66326	1154	19·	"	"	"	"
5	17	"	"	"	67400	1074	17·9	"	"	"	"
6											
	19·2	44 ins.					18·8				1652

Remarks.—December 27, at 2h. 10′, P. M., started fires; had steam at 3h. 45′, and at 4 h. 29′ left the wharf. At 5h. 12′ passed the Boston light, wind and tide fair; register showing 740 revolutions. At 6h. 25′ set topsails. At 9h. 7′ Cape Cod light abeam; register 4865 revolutions. At 10h. 17′ Nauset light abeam; register 6088 R. At 11h. 35′ Chatham light abeam; register 7502 R., wind light, smooth sea.

December 28. At 12h. 15′ took in topsails. At 12h. 30′ passed Pollock's Rip light boat; register 8443 R. At 2h. 11′ abreast of Cross Rip light boat; register 10,201 R. At 3h. 39′ Holmes' Hole; register 10,860 R. At 4h. 44′ Gay Head light, register 12,854 R. At 7h. 25′ set fore and main spencer, smooth sea, light airs. At 3h. P. M. took in all sails.

December 29, A. M. This day commences with light winds ahead, and smooth sea. At 6h. A. M., set fore and main sails. At 9h. took in all sails, wind light and smooth sea the remainder of the day.

December 30, A. M. At 12h. 47′ abreast of Sharp's Island. At 3h. 20′ slowed engine. At 4h. 29′ North Point abeam, light airs, smooth sea; register 66,893 R. At 5h. 40′ came to at the dock; having made from Boston to Baltimore, 68,022 revolutions, 61 hours running time.

The average results obtained from this log, are as follows; and, as in the former case, will constitute the basis of the investigation for the return trip.

Average coal consumed per hour,	1652 lbs.
" steam per gauge,	19·36 ins.
" cut-off,	41·71 ins.
" revolutions per minute,	18·43
" vacuum,	25 ins.
" temperature of hot-well,	115°
" " feed water, (heated,)	139°
" density of boiler water,	$1\frac{3}{4}$

The running distance, as before stated, is 666 nautical miles. Total number of revolutions made, 68,022. Running time 61 hours.

Boilers.—Burning 1652 pounds of coal with an average steam pressure of 19·36 lbs. per square inch, and cutting off at 41·7 inches, the evaporation was as follows, $\frac{66{\cdot}72 \times 36{\cdot}86}{788} = 3{\cdot}12$ and $\frac{3{\cdot}12 \times 60 \times 64{\cdot}3}{1652} = 7{\cdot}3$ lbs. of water evaporated to the pound of coal.

Loss from blowing off at $1\frac{3}{4}$,	.	15·02 per cent.
Gain by heater,	2·5 per cent. or $\frac{44}{100}$	tons of coal.
Coal consumed per hour per square foot of grate,	. .	13·7 lbs.

Performance of Engine.—The mean performance for the run of 61 hours was as follows:

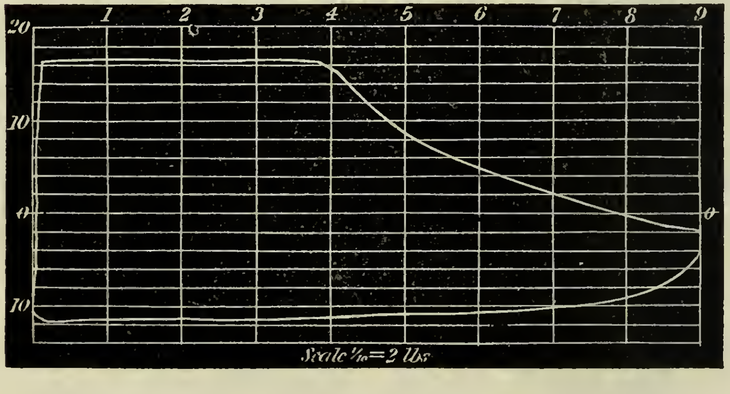
$\frac{2507{\cdot}1 \times 21{\cdot}8 \times 331{\cdot}74}{33000} = 549{\cdot}43$ total developed power, the distribution being as follows:

Oblique action and slip, .	31·19	per cent. or	171·36	H. P.
Friction of engine, . .	5·00	"	27·47	"
" load, . .	4·60	"	25·07	"
Power required to work air pump, .	4·50	"	24·72	"
Leaving to be utilized in propelling the ship,	54·71	"	300·58	"
	100·00	"	549·20	

Proportion of immersed sectional area to effective horse power, 1·09 to 1.

The following diagram will show the working condition of the engine.

Steam 19½. Revolutions 18. Vacuum 26. Hot-well 115°.



A Brown Ink for Marking Linen.[*]

The solution for writing consists of ½ an ounce of acetate of manganese in 1½ ozs. of water: the linen is prepared by saturation with a solution of 1 drm. of prussiate of potash, stiffened with 1½ drms. of gum-arabic, drying and ironing.—*Würzb. Wochenschrift*, 1855, No. 10.

[*] From the Lond. Chem Gaz., No. 320.

For the Journal of the Franklin Institute.

Particulars of the Steamer Eastern Queen.

Hull built by John Englis, New York. Machinery by Morgan Iron Works, New York. Owners, Captain Kemble and others. Intended service, Boston to Gardiner.

HULL.—	
Length on deck,	220 feet.
Breadth of beam, (molded,)	29 "
Depth of hold to spar deck,	11 " 3 inches.
" keel,	6 "
Tonnage,	700.
Area of immersed section at load draft,	173 sq. feet.
Contents of bunkers in tons of coal,	150.
Masts—two—Rig—schooner.	
ENGINES.—Vertical beam.—	
Diameter of cylinder,	48 inches.
Length of stroke,	11 feet.
Cut-off,	at one-half.
BOILER.—One—Return flued.—	
Length of boiler,	28 feet.
Breadth "	12 " 6 inches.
Height " exclusive of steam chimney,	11 "
Number of furnaces,	3.
Diameter of shell,	10 "
Length of grate bars,	7 " 2 "
Number of flues,	above 5—below 10.
Internal diameter of flues above,	18½ "
" " below, six,	13 "
ten,	12 "
ten,	18 "
Diameter of smoke pipe,	4 feet 6 inches.
Height "	32 "
PADDLE WHEELS.—	
Diameter over boards,	30 "
Length of blades,	8 "
Depth "	2 " 2 "
Number,	26.

Remarks.—Frames *molded* 14 ins ; *sided* 6 and 7 ins. ; 24 ins. apart from centres, and strapped with diagonal double laid braces 4 × ½ inch. Blowers to furnaces.

C. H. H.

For the Journal of the Franklin Institute.

Comparative Results attained by Rising Flue Boilers and Martin's Vertical Tubular Boilers in the U. S. Steamer Susquehanna.

The following data, compiled carefully from the logs of the abovenamed steamer, have been furnished us from a reliable source, and are interesting as showing the economic gain in the use of well designed vertical tubular boilers. To appreciate the whole gain by the latter, the great saving of space from that occupied by the old form of boiler ought not to be overlooked. Particulars of both sets of boilers have previously appeared in this *Journal*.

Summary of Abstracts of the Steam Logs of the U. S. Steamer Susquehanna. From June 1st, 1851, to March 31st, 1855—WITH OLD BOILERS.

Total time		Steam alone.		Steam & Sail.		Sail alone.		Average pressure of steam.	Average revolutions per minute.	Avr'ge speed per hr. knots	Aver'ge coal consumed per hour.	Total coal consumed tons.	Total distance run.	Dist'nce with sail alone.	Dist'ce with steam alone and steam & sail.
Days.	Hrs.	Days.	Hours.	Days.	Hours	Days.	Hrs.								
337	5	194	2	131	4	11	23	lbs. 9·1	10	7·25	lbs. 3362	11·000	61,129	2251	58878
From May 1st to September 30th, 1856—WITH NEW BOILERS.															
From May 1st to July 31st.															
44	15	19	11	15	1			11·4	11·3	8·3	2595	1·404	8715		8715
From August 5th to September 30th. Frigate Congress in tow.															
8	4	84						11 2	11	6·5	2860	318	1248		1248
Total average with "new boilers."															
52	19	37	18	15	1			11·35	11·25	8	2752	1722	9963		9963

By reducing these abstracts to one common standard of speed, by means of the ordinary rules applied for that purpose, with the view of obtaining the relative economy of fuel, and by taking the "logs" of the ship with "old boilers" as the basis of calculation, having special reference to speed and coals, we obtain the following comparative results:

The performances of the ship under ordinary circumstances, (with the ship alone,) is found to be as 100 : 182, or 45 per centum in favor of the new boilers.

With the Frigate *Congress* in tow, it was as 100 : 87, or an expenditure of only 13 per cent. more fuel whilst the ship was performing double duty.

A general mean of performances with "new boilers," is as 100 : 134, or 25 per cent. in their favor under all circumstances (including time of towing, &c.)

*The Atlantic Submarine Cable.**

The projected telegraphic communication between this country and the United States is of such vast importance, that any suggestions tending to its successful completion are worthy the consideration of the directors of the scheme.

The object of this letter is to draw attention to the probable effect of the immense pressure to which the insulated wire will be exposed when sunk in the Atlantic. Supposing the gutta percha coating to be perfect, no injury can be sustained by this pressure ; but in case of there being any "*blows*" (air holes) that have merely a skin of gutta percha over them, the water under so enormous a pressure would soon find its way to the wire and destroy the insulation, and so render the cable useless. These defects would not be perceived by ordinary testing, such as immersing the cable in a few feet of water.

The plan of testing I should propose, is to construct large cast iron tanks in which some hundred miles of cable can be placed, with stuffing boxes where the wire enters and leaves the vessel, and then subjecting it to hydrostatic pressure; the insulated wire to be connected through a galvanometer with one pole of a powerful intensity battery, and the iron of the tank, in which the cable is enclosed, with the opposite pole.

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* From the Practical Mechanic's Journal, Feb., 1857.

Chester, January, 1857. J. H.

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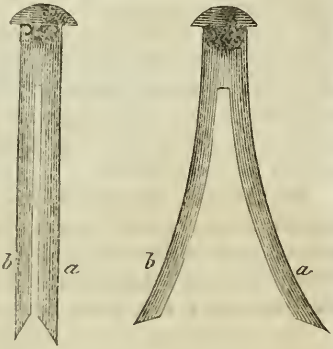
*Westley's Expanding Spikes.**

Mr. William Westley, of Wellington, Derby, has patented the improved nail or spike shown in the annexed engravings. The body of the nail or spike is split into two legs or fangs, *a b*, fig. 1, which are chamfered or beveled at their ends, the said beveled ends constituting two edges, the inclined faces of which are turned towards each other. In driving the nail or spike into wood or other substance, the wedge-shaped ends, in consequence of their inclined faces being turned towards each other, cause the two halves, *a b*, to open, in the manner represented in fig. 2, and thus fix themselves firmly in the material.



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* From the Lond. Mech. Mag., Nov., 1856.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, April 16th, 1857.

John Agnew, Vice President, in the chair.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

Letters were read from the K. K. Geological Society, Vienna; Smithsonian Institute and the Metropolitan Mechanics' Institute, Washington City, D. C.

Donations to the Library were received from The Royal Astronomical Society, London; K. K. Geological Society, Vienna; L. A. H. Latour, Esq., Montreal, C. E.; United States Coast Survey; Prof. A. D. Bache, Washington City, D. C.; Hon. Job R. Tyson, U. S. Congress; Regents of the University of the State of New York; State Lunatic Asylum, Albany, New York; Academy of Science of St. Louis, Missouri; C. M. Saxton & Co., New York; Philadelphia, Wilmington, and Baltimore Railroad Company, the Coal Run Improvement and Railroad Comp., McKean & Elk Land and Improvement Company; Girard College; Pennsylvania Institution for the Blind; Prof. John F. Frazer, Prof. J. C. Cresson, Dr. B. H. Rand, and F. de B. Richards, Esq., Philadelphia.

Donations to the Cabinets from Ellwood Morris, Esq., Cold Spring, Penna., B. I. Shreve, near Mount Holly, New Jersey, and Stephen Ustick, Esq., Philadelphia.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer's statement of the receipts and payments for the month of March was read.

The Board of Managers and Standing Committees reported their minutes.

Candidates for membership in the Institute (3) were proposed, and the candidates proposed at the last meeting (4) were duly elected.

William Butcher & Son presented some specimens of their gum elastic coated and impregnated iron, the patent right of which has been secured. Mr. Butcher stated that this material is now in great demand for roofing, and other uses where iron is exposed to the atmosphere; there being no galvanic action between the iron and its coating, he considered it superior to any other material used for roofing or other purposes. The subject is referred to the Committee on Science and Arts of the Institute for examination.

Mr. John H. Cooper exhibited and explained his very ingenious and simple rotary press for printing by hand, by means of which every person can do his own printing. It is now before the Committee on Science and the Arts, constituted by the Institute, and will be more fully described in a future number of the *Journal.*

BIBLIOGRAPHICAL NOTICE.

Chinese Sugar Cane and Sugar making; its History, Culture, and adaptation to the Climate, Soil, and Economy of the United States, with an account of various Processes for Manufacturing Sugar. By Charles F. Stansbury, A. M., New York : C. M. Saxton & Co., 12 mo. pp. 106.—25 cents.

Mr. Stansbury has made a very useful contribution to the knowledge of our farmers especially, and our community in general, by collecting together the information in reference to the cultivation of *Sorgha* or Chinese sugar cane. It appears from the results of the experiments here recorded, that it is likely to form a very great accession to our valuable plants, not only as a means of obtaining sugar, and its secondary products the fermented and alcoholic liquors, but also, as a fodder, in which respect, according to the testimony of those who have tried it, it possesses great advantages.

The subject belongs rather to our Agricultural Society than to us, but as agriculture lies at the base of the prosperity of every nation aspiring to be independent, the subject is of vast importance as well to our mechanic arts, and we recommend this little work to all our readers, who, as we learn by an appended advertisement, can, for twenty-eight cents, obtain it and seed enough of the plant to plant two square rods, from the publishers.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

JUNE, 1857.

CIVIL ENGINEERING.

*Description of the Compressed Air Engine at Govan Colliery.**

By W. C. Randolph.

[Read before the Institution of Mechanical Engineers, Glasgow.]

This engine was designed for a special purpose in the working of the Govan Colliery, near Glasgow, where an ordinary engine was not applicable; and although under other circumstances not an economical mode of employing power, it has proved in the present case highly satisfactory, and has worked successfully for several years.

The main shaft is sunk 176 yards deep, through six successive seams of coal, the first of which is 92 yards from the surface at that point; and after working the coal at that part, a main road was driven horizontally to a distance 706 yards, intersecting the coal seams, which dip at an inclination of about 1 in 11. A second shaft, at present 26 yards deep, was then sunk near the extremity of the main road, for the purpose of working the third seam, or "rough main" coal. The difficulty then arose of providing for the winding and pumping of this second shaft at a distance of nearly half a mile from the first shaft. A steam boiler was inadmissible in that situation, and the distance was too great to convey steam from the surface. Some application of water power was contemplated by the manager, Mr. James Allan, who applied to the author for the purpose of carrying it out; and it was then proposed by the author, upon the original idea suggested by Mr. David Elder, to make use of compressed air supplied by a compressing steam engine at the surface, and conveyed down by a pipe, to work an engine at the top of the second shaft, in the manner of a non-condensing steam engine, the discharged air being thrown into the workings to aid in the ventilation of the mine. This proposal was adopted, and the present engine was designed and constructed for the purpose, by Messrs. Randolph, Elliot & Co.; it has now been working at the colliery more than six years, and has been found to answer the purpose completely.

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*From the Lond. Mech. Mag., Feb., 1857.

The main shaft contains a single winding apparatus and a set of four pumps, and forms the downcast shaft for the ventilation; it is 18 feet long and 8 feet wide, being oval at the top and rectangular below. It opens at the bottom to the horizontal main road, which is 9 feet wide and 6 feet high, divided by a brattice in the centre throughout the whole length, for the downcast and upcast currents. The upcast shaft, 7 feet diameter, has a ventilating furnace at the bottom, and contains a single winding apparatus. In a recess at the top of the second shaft, is fixed the air engine for working the winding and pumping apparatus of the second shaft. The compressed air is conveyed to it by a cast iron pipe, 10 inches diameter inside, carried down the main shaft, from a steam engine at the surface, which is employed to compress the air.

The steam cylinder is 15 inches diameter, with a stroke of 3 feet, and drives two condensing air pumps, which work alternately one on each side of the beam centre, delivering the air into the centre reservoir, from which it passes into the main pipe. The beam is connected at the other end to a crank and fly-wheel, to equalize the motion. The air pumps are 21 inches diameter, with a stroke of 18 inches; they are placed inverted, with the piston rods passing out below, where the stuffing boxes are not exposed to the pressure of the compressed air, and are worked with crossheads sliding in vertical guides by means of side rods from the beam. The air pumps are fitted with ball-valves, of which there are three sets to each pump, each set consisting of 44 brass balls, 2 inches diameter, arranged in three concentric rings. The balls are confined by separate cages to a lift of half an inch. In consequence of the high pressure of the air, amounting to 30 lbs. per square inch, provision is made for preventing leakage through the valves, by a stratum of water constantly covering the piston valves and the delivery and inlet valves, through which all the air has to pass. A small pump, 3 inches diameter and 10 inches stroke, is employed to supply water for this purpose, and delivers it into the centre reservoir, from which it flows through the small pipes, into each of the air pumps, during the period of their downward strokes, the quantity of water admitted being regulated by a cock in each pipe. The surplus water is discharged at each upward stroke through the delivery valves, and flows over the top into the centre reservoir, keeping the delivery valves also covered with water; in this way the compressed air is entirely discharged, and there is no loss of power from expansion of air behind the piston at the beginning of the downward stroke. The level of water in the centre reservoir, is regulated by means of a gauge glass at the side. Any leakage of water past the piston valves and piston, escapes through the suction or inlet valves, and is carried off by a waste pipe fitted to the casing of the air pumps.

The air pump barrels are lined with brass to prevent corrosion, and the pistons are faced with brass and without packing, being merely turned a good fit to the cylinders. The pumps have continued working the whole time since starting, a period of more than six years, working part of the time day and night, without requiring any repairs or adjustment; nothing has been done to them, except replacing some of the valve cages which had been broken.

The usual speed of this engine is about 25 revolutions per minute, with a pressure of steam of 18 lbs. per square inch, giving a pressure of air averaging about 20 lbs. per square inch.

The air engine at the lower shaft has a cylinder 10 inches diameter and 18 inches stroke, and works usually at about 25 revolutions per minute; it is an old steam engine, and was formerly worked with high pressure steam. It was intended to be worked with air at 30 lbs. per square inch pressure, and at that pressure the heat generated in compression was expected to be very great; indeed, calculation at the time gave nearly the melting point of tin. The great safety valve, however, for getting rid of the heat developed, is, as was anticipated, the water upon the valves of the compressing engine, which absorbs the heat as soon as generated, a portion of the water passing off through the main pipe in the form of steam; this steam becomes condensed in the pipe, and provision is made for drawing off the water of condensation from time to time as it accumulates at the bottom of the shaft, by means of a cock.

The pressure of the air at the lower engine, is only about 1 lb. per square inch below the pressure of the compressing engine at the top of the pit. The absorption of heat on the sudden liberation of the compressed air from the lower engine, at the discharge of each stroke, causes so great a degree of cold, that in winter the engine is often stopped by the formation of ice in the cylinder and exhaust pipe.

On the Geology and Physical Geography of North America.[*] By Prof. Henry D. Rogers, from the United States.

(Continued from page 326.)

American Coal Fields.

The speaker selected from the many topics presented by this sketch of the geology of North America, that of the coal fields of the United States and British Provinces, as presenting a theme of general interest, describing first briefly the carboniferous formations, especially their coal measures.

This formation consists, in the United States and North-eastern British Provinces, of argillaceous and siliceous sandstones, conglomerates, clay shales, fire clays, and coal slates; argillaceous limestones, chiefly of marine origin, and seams of coal. A coarse siliceous conglomerate or millstone grit, generally destitute of coal, underlies the productive coal measures throughout nearly all the different basins, proving the universality of the action which attended the commencement of that state of the physical geography that witnessed the production of the coal seams and the sediments which enclose them.

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[*] Notices of the Meetings of the Royal Institution of Great Britain, Feb. 8th, 1856.

The eastern half of the continent exhibits five great coal fields, extending from Newfoundland to Arkansas. 1. The first, or most eastern, is that of the British Provinces, Newfoundland, Nova Scotia, Cape Breton, Prince Edward's Island, and New Brunswick. This seems to have been originally one wide coal field, subsequently broken up into patches by upheval and denudation, and by the submergence which formed the Gulf of St. Lawrence: the area of the coal measures of the provinces is probably about 9000 square miles, though only one-tenth of this surface appears to be underlaid by productive coal seams. 2. The second, or great Appalachian coal field, extends from North-eastern Pennsylvania to near Tuscaloosa, in the interior of Alabama. It is about 875 miles long, and 180 broad, where widest in Pennsylvania and Ohio, and by a careful estimate contains about 70,000 square miles. The narrow basins of anthracite in Eastern Pennsylvania, containing less than 300 square miles of coal, are outlying troughs from this great coal field. 3. A third, smaller coal field, occupies the centre of the state of Michigan, equidistant from Lake Huron and Michigan; it covers an area of about 15,000 square miles, but it is very poor in coal. 4. A fourth great coal field is that situated between the Ohio and Mississippi anticlinals, in the States of Kentucky, Indiana, and Illinois. It has the form of a wide elliptical basin. It is about 370 miles long, and 200 miles wide, and contains by estimation 50,000 square miles of coal measures. 5. The fifth, and most western, is the large and very long coal field filling the centre of the great basin of carboniferous rocks which spreads from the Mississippi and Ozark anticlinals, westward to the limit of the palæozoic region, where the cretaceous strata begin. The coal field itself has its northern limit on the Iowa River, and its southern near the Red River, on the western border of Arkansas. It is in length 650 miles, and in greatest breadth 200 miles. The total area of this great irregular basin is probably not less than 57,000 square miles. Three or more small detached tracts of coal strata, encompassed by the cretaceous deposits, stretch at intervals south-westward from the southern limit of the longer field through Texas. They are probably extensions of the great field laid bare by denudation. Other localities of coal bearing strata occur in the high table lands on both sides of the Rocky Mountains, and also in the Wahsatch chain of Utah, but it is doubtful whether any of them belong to the true carboniferous series. The aggregate space underlaid by these vast fields of coal amounts to at least 200,000 square miles, or to more than twenty times the area which includes all the known coal deposits of Europe, or indeed, of the whole eastern continent.

These coal fields, especially the four lying west of the Atlantic slope, exhibit several interesting facts of gradation, which render it highly probable that they were, at one time, all of them connected, the vacant intervals now separating them having been denuded of their coal measures by the wide-sweeping erosive action of the waters of the Appalachian Sea, set in motion by the uprising of this part of the continent. The first fact of such gradation relates to the thickness of the formation, and that of the individual coal seams in the respective coal fields, the comparison indicating a marked reduction in this respect from east to west. Thus the productive coal measures of Nova Scotia have a thickness of nearly 3000 feet, those of the anthracite basins of Pennsylvania a depth about as great, while those in the central parts of the great Appalachian basin show a thickness not exceeding 2500 feet. Again, in the Illinois basin the probable thickness is reduced to 1500 feet, while in the farthest, or Ohio and Missouri basin, it cannot exceed 1000 feet. Very similar is the reduction in the number of the coal seams. Those at the Joggins, in Nova Scotia, are about 50; though only five of them are of workable dimensions, being equivalent to about 20 feet of coal. The deepest anthracite basin of Pennsylvania, that of the Schuylkill, contains also about 50 coal seams, but 25 of these have a thickness each of more than three feet, and are available for mining. Further west, the great Appalachian coal field contains about 20 beds in all, 10 of which are thick enough to be mined. Still farther onward, the broad basin of Indiana and Illinois shows apparently not more than 10 or 12 beds, and it is believed that only 7 of these are thick enough and pure enough for mining. Northward, in the Michigan coal field, denudation has left only the two or three lower beds. Still further westward the coal field of Iowa and Missouri contains, it is believed, but 3 or 4 beds of profitable size, and the total number, thick and thin, does not exceed 6 or 7. A similar gradation is noticeable in the general size of the individual coal seams, by far the thickest being in the anthracite basins of Eastern Pennsylvania.

Parallel with this progressive reduction in the amount of land-derived material in the upper coal formation, is a diminution in the coarseness of the mechanical ingredients of the strata, the eastern coal measures having more conglomerates and coarse sandstones, the western, more fine-grained argillaceous sandstones and clay beds; and as a further indication that the first land lay to the east and the ocean to the west, of the wide coal-producing plains or meadows, there is with this westward reduction of the mechanically derived sediments from the land, a steady augmentation of marine limestones, and other true aqueous deposits, precipitates of a shallow carboniferous sea. In some of the more western coal fields the alternation of the terrestrial coal seams with super-imposed limestones, containing marine fossils, amounts even to an occasional actual contact of the two kinds of strata.

Apart from these general phenomena of gradation which belong to the conditions under which the strata originated, there exist other facts of transition, which also imply a declension westward, of quite another class of forces than the productive ones. In the Appalachian chain, all the eastern coal basins, and the eastern margin of the great Appalachian field, give evidence of a crust metamorphism, affecting all the palæozoic rocks, the degree of alteration dependent on the nature of the stratum, and its situation, eastward or westward, in this great undulated zone. The coal, of all rocks the most sensitive to metamorphism from heat, presents invariably among the eastern flexures of the Appalachians, where the crust action has been greatest, the condition of a hard and flinty anthracite with a jaspery or large conchoidal fracture; further westward in the same set of basins, the anthracite has a more cuboidal fracture, is softer, and is even slightly gaseous. Entering the eastern border of the great Appalachian bituminous coal field, we everywhere find the coal possessed of only half its full share of volatile or gaseous matter; and it is not until we reach the middle and western side of this wide basin, that the coal is found fully bituminous,—in other words, not until we pass beyond the last of the perceptible undulations of the crust. Throughout all the flat fields of the Western States, the coal invariably retains its original full amount of bituminous or gaseous ingredients.

Comparing the areas of the coal fields of other countries with those of North America now indicated, Great Britain may be estimated to contain about 5400 square miles, France 1000, and Belgium 510 square miles. Rhenish Prussia—Saarbrook field—has 960 square miles, Westphalia 380, the Bohemian field, about 400; that of Saxony, only 30; that of the Asturias, in Spain, probably 200; and that of Russia, scarcely 100 square miles. And as these are the principal known coal fields in Europe, the whole is thus seen to possess less than 9000 square miles of productive coal measures. Comparing the coal areas with the total areas of the respective countries, the United States has one square mile of coal field to each 15 square miles of its 3,000,000 miles of territory; Great Britain has one square mile to each 22½ of surface; Belgium a like proportion; while France possesses only one square mile of coal field to every 200 miles of country. Assuming the total area of the productive coal measures of the world at 220,000 square miles, and accepting 20 feet as the average thickness of the available coal, the entire quantity, if estimated as one lump, is equivalent to a cube of very nearly 10 miles dimensions, or equivalent to a cake or plateau of coal 100 miles square in its base, and 440 feet high.

The present annual product of the chief coal producing countries is as follows:—Great Britain extracted from her coal mines last year—1855—the enormous quantity of 65,000,000 tons; the United States, between 8 and 9,000,000; Belgium, about 5,000,000; and France, 4,500,000.

It is interesting to compare the dynamic force of coal applied as fuel to the generation of steam in the steam engine, with the dynamic effect of a man. The human laborer, exerting his strength upon a treadmill, can raise his own weight, say 150 lbs., through a height of 10,000 feet per day, equivalent to 1 lb. raised 1,500,000 ft. The mechanical virtue of fuel is best estimated by ascertaining the number of pounds which a given quantity, say one bushel, will raise to a given height, say one foot, against gravity. In the steam engine this is called the *duty of the fuel.* Now, the present maximum duty of one bushel of good coal in the improved Cornish steam engines, is equivalent to 100,000,000 lbs. lifted through one foot; but one bushel has been made to raise 125,000,000 lbs. one foot high, or one pound 125,000,000 of feet; but as there are 84 lbs. in one bushel, this divisor gives one pound as equal to 1,500,000 ft.; just the result of a man's toil for one day upon a treadmill. Thus a pound of coal is really worth a day's wages. If we estimate a lifetime of hard work at 20 years, giving to each year 300 working days, we have for a man's total dynamic effort 6000 days. In coal this is represented by the amazingly small amount of *three tons*. Another proof of the extraordinary power derivable through the combustion of fuel, is presented in the following calculation ; one cubic inch of water is convertible into steam, of one atmospheric pressure, by 15⅓ grains of coal, and this expansion of the water into steam is capable of raising a weight of one ton the height of a foot. The one cubic inch of water becomes very nearly one cubic foot of steam, or 1728 cubic inches. When a vacuum is produced by the condensation of this steam, a piston of one square inch surface, that may have been lifted 1728 inches, or 144 feet, will fall with a velocity of a heavy body rushing by gravity through one-half of the height of the homogeneous atmosphere, or through 13,500 feet. This gives a terminal velocity of 1300 feet per second, greater than that of the transmission of sound. From this we can form some estimate of the strength of the tempest which alternately blows the piston in its cylinder, when elastic steam of high pressure is employed. Applying the calculations of the dynamic efficiency of coal, for estimating the mechanical strength latent in the coal fields of the earth, or in the large coal product annually furnished by the mines of Great Britain, we get some interesting results. Each acre of a coal seam, four feet in thickness, and yielding one yard nett of pure fuel, is equivalent to about 5000 tons ; and possesses, therefore, a reserve of mechanical strength in its fuel equal to the life-labor of more than 1600 men. Each square mile of one such single coal bed contains 3,000,000 of tons of fuel : equivalent to 1,000,000 of men laboring through twenty years of their ripe strength. Assuming, for calculation, that 10,000,000 of tons, out of the present annual product of the British coal mines, namely 65,000,000, are applied to the production of mechanical power, then England annually summons to her aid an army of 3,300,000 fresh men, pledged to exert their fullest strength through 20 years. Her actual annual expenditure of power, then, is represented by 66,000,000 of able-bodied laborers. The latent strength resident in the whole coal product of the kingdom may, by the same process, be calculated at more than 400,000,000 of strong men, or more than double the number of the adult males now upon the globe.

Climates.—Adverting to the causes of the characteristic features of the North American climates, those of all the eastern and northern divisions of the continent were shown to depend primarily upon the peculiar distribution of the land and water, and the general circulation of the winds and oceanic currents in the North Atlantic and the Polar Basins, resulting from general phenomena of rotation of the fluids, and from the configuration of those seas. The chief surface currents of both these basins belong all to one great circulating stream, which, crossing the Atlantic from Africa to the Gulf of Mexico, under the northern tropic, and following for a vast distance the highly-heated shores of South and Central America, enters the North Atlantic at Florida, under the name of the Gulf Stream, carrying a temperature of 5° to 6° higher than the mean heat of the equator, and imparting to the southern coast of the United States the ocean temperature of the tropics. Pursuing its career to the north-east, this current transports its own mild climate to the whole north-western side of Europe, and even subdues the rigors of the European Polar Sea; but refrigerated, as it sweeps round in its circumpolar course, the shores of Siberia and Western Arctic America; and, loaded with the annual ice of all that extended zone, it streams through the great Archipelago of North-eastern Arctic America, clogs its deep channels with its floating packs of ice, and chills to the zero temperature of the whole hemisphere this coldest of all the summer climates of the globe. Returning into the Atlantic around Greenland, and by its main passage through Baffin's Bay, this now Arctic ice-chilled and ice-transporting current, hugs the whole north-eastern coast of the continent inside of the Gulf Stream. It thus weaves a track somewhat resembling the figure 8. The Gulf Stream on the south-east, and the Arctic current on the north, conjointly with the tropical and the polar winds with which they are connected, produce such a contrast in the temperature of the southern and northern latitudes of eastern America, that all the zones of the climates of the sphere are there compressed within not more than 30° of a great circle, crossing the continent from the Gulf Stream to lat. 70° north of Hudson Bay.

The climatology of the western half of the continent was next discussed. There the controlling agent in the latitudes north of the north-east Trade Wind of the tropic, is the south-west and west wind from the Pacific Ocean, and in the Southern Atlantic States from the Gulf of Mexico. This Pacific Ocean wind, moderately charged with moisture in the lower latitudes, and excessively humid in the more northern ones from traversing a wider tract of sea, confers a temperate, moist, and oceanic climate upon the Pacific slope; but deprived largely of its moisture by ascending the high mountain barrier of the Pacific chain, which robs it of nearly the whole of its wetness, it exerts in the more southern latitudes just the opposite effect upon the plains and table lands to the leeward or eastward of that barrier. The high evaporative power of the winds thus parched accounts for the excessive aridity of the Colorado and Utah deserts, and the whole desert belt of the interior which in the lower latitudes stretches to Texas. It likewise explains the prevalence of numerous salt lakes, destitute of outlets, and the occurrence of the wide tracks covered with salt, or with a saline soil, within this area.

Gold.—To the same general cause, the Pacific wind, we are to attribute the abundant gold alluvia of the western slope and base of the Sierra Nevada. The copious precipitation of rain, amounting to nearly the whole humidity of the Pacific wind, against the gold containing western flank of the Californian chain, greater probably in the pleistocene than in the modern epochs, has produced an enormous erosion of the gold-bearing and cleavage fissured rocks; and has strewn and sorted their fragments and particles in the ravines of the mountain, and in the plains at its base. The speaker concluded with an announcement of the general fact that, whereas the salt fields of the earth are found upon the continental or interior dry sides of its oceanic chains, its gold fields are restricted to their wet or oceanic slopes.

Atlantic Telegraph Cable.[*]

We have been favored by the contractors for the Atlantic telegraph, with a piece of the cable for the deep sea. This cable consists of a central copper strand of seven small copper wires of No. 22 gauge, acting as the conductor through which the signals are to be transmitted. Owing to the retardation which experiment has disclosed to exist in large wires, these small wires are found necessary. Each or all seven together act as a conductor. The strand of the seven copper wires, about one-tenth of an inch in the cable diameter, is surrounded with a coating of gutta percha, averaging about 0·15 inch thick. This gutta percha is again closely and tightly covered with 18 strands each, consisting of 7 iron wires, the object of which is to protect and keep close the gutta percha round the conducting strand of copper, and to give strength to the cable. To prevent the oxidation of the iron wire under water, which unprotected would be rapid, a mixed solution of Stockholm tar and pitch, well rubbed in, coats the iron strands.

From the specimen before us, the cable is exceedingly well made, and though compact and strong, is sufficiently flexible. Its weight is 19 cwt. to a mile, and Messrs. Kuper & Co., who have 1260 miles to make in one length, and to lay in the Atlantic, are to have it on board ship by the end of next June. The other portion of the cable is making in America, and will start about the same time from the American side, to meet midway the vessel carrying the English portion of the cable.

A sort of plateau of sand has been discovered running across the Atlantic on which the cable is to be laid. The greatest depth by soundings appears to be 2070 fathoms, giving a pressure of water per square inch of 6210 lbs., or nearly three tons.

Two causes of apprehension existed with regard to the success of a telegraphic communication across the Atlantic. One was that the great pressure of water would penetrate any supposed insulation of the conducting wires, and consequently disperse or so weaken the magnetico-electric current as to prevent the action of the needle on the other side, or it might so change the molecular arrangement of the copper particles as to materially interfere with, if not destroy, the transmission of the signals. Mr. Glass, however, informs us, that a pressure of four tons to the square inch has been used on the cable, and no sensible disturbance produced, which of course disperses to the winds the first apprehension.

The second apprehension arose from an experimental fact, on the Anglo-Belgian submarine cable, that the signals transmitted through a cable submerged to any depth suffered a very sensible retardation and lingering, in only about 300 miles. From this fact it was therefore feared that in a cable of ten times the length, exposed to much greater depths and pressures, the definition of the signals, if they should ever reach the opposite shores, would be so feeble and imperfect as to be unintelligible, and so slow in their transit as to be comparatively useless. Mr. Whitehouse, however, the engineer of the Company, has, by sending alternately positive and negative currents, obviated greatly, if not wholly, this difficulty, increased the number of the repetitions of signals, and sharpened their definition. He seems to think that the alteration of opposite currents clears out the wire from any lingering remains of the preceding signal. Whether this be so or not, if the lingering action be destroyed, a greater number of signals can be transmitted, and the grand desideratum of the telegraph—instantaneous transmission—be more nearly approximated.

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[*] From Herapath's Journal, No. 923.

Our government, it is known, proposes to allow the Company £14,000 a year for such use of the telegraph as it may require. The American government is said to have consented to allow an equal sum, which together, will give $9\frac{1}{3}$ per cent. on the estimate of £300,000.

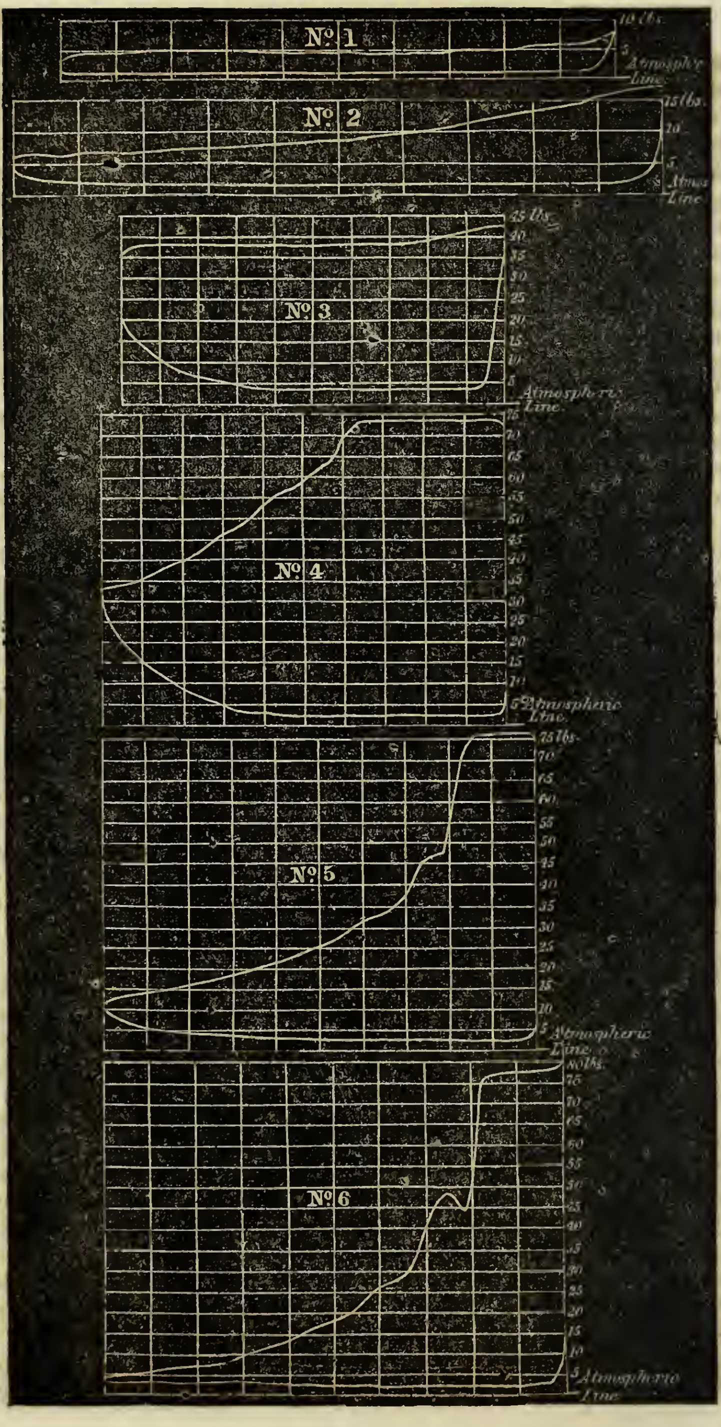
For the Journal of the Franklin Institute.

Experiments made at the Steam Flour Mills of Messrs. Hecker & Brother, New York. By Chief Engineer, B. F. Isherwood, U. S. Navy.

(Continued from page 309.)

With regard to the back pressure on the pistons, it will be observed, that, excepting series D and F, it steadily increased with the increase of the final pressure at the end of the stroke of piston, ranging from 1·65 to 5·00 pounds per square inch above the atmosphere, for final pressures of from 3·60 to 30·68 pounds per square inch above the atmosphere. The area for the exhaust is really the same as for the steam, though the exhaust port itself is larger, because the exhaust steam must first pass through the steam port before it can enter the exhaust port; and from the foregoing it will be seen, that this area was too small when any considerable quantity of steam was exhausted through it. There is also another fact to be prominently noted in this connexion; it is that although the surface condenser condensed *all* the exhaust steam, yet in no case, not even when using the small amount of steam required to work the engine and shafting *per se* at the slowest speed, did the back pressure fall to less than one pound per square inch above the atmosphere. At this time and for the purpose of testing this point of minimum possible back pressure, the surface condenser was flooded by the independent steam pump with a copious supply of water, but little above the freezing point. There was particular attention paid to this fact, because it is a common though very erroneous opinion among a large number of engineers, that with non-condensing engines exhausting through a "heater," which, to a certain degree, acts as a surface condenser, it is possible to reduce the back pressure below the atmosphere. This opinion is very prevalent on the Western rivers where such engines are wholly used, and although such a result is manifestly impossible, as it involves a contradiction to the best established law of physics, viz: the equality of pressure and resistance, yet as it was held by many practical men it was thought as well to practically refute it.

An inspection of the columns headed "Relative Economy of Fuel," will show, in a striking manner, the immense influence exerted on the economical result by the "Ratio of the back Pressure to the total Average Pressure." For instance, comparing Series A and B, whose points of cutting off, and whose actual coefficients of the expansion of the steam are substantially the same, but whose ratio of the total back pressure to the total average pressure vary as 0·478 and 0·591, leaving with Series A, (1·000—0·478 =) 0·522, and with Series B, (1·000—0·591 =) 0·409 of the pressure to be applied to the development of power; we have the relative economy of fuel as 1·923 to 2·536 or as 1·000 to 1·319; but 0·409 and 0·522 compare as 1·000 to 1·276, or nearly the same; showing that the great difference of 32 per centum in the consumption of fuel for equal powers in the two cases, was caused entirely by the difference of the ratios of the back pressure to the average total pressure. Again, if we compare Series C and G, in which the points of cutting off are respectively 0·348 and 0·237 of the stroke: but in which the ratios of the back pressures to the total average pressures are 0·280 and 0·340, leaving with Series C (1·000—0·280 =) 0·720, and with Series G, (1·000 —0·340 =) 0·660 of the pressure to be applied to the development of power, we find, that notwithstanding the greater economy to be derived from cutting off shorter in Series G, yet the economical result with the fuel was precisely the same in both cases, owing to the fact, that with Series G, the ratio of the back pressure to the total average pressure was so much higher than in Series C, as to exactly balance the gain by the greater expansion. Once more, if we compare Series E with Series I, we shall find the economy of fuel to be greater with E than with I in the ratio of 1·257 to 1·358, although the point of cutting off with the former was 0·298, and with the latter 0·152 of the stroke, the difference of the gain by the greater expansion being overbalanced by the loss from the greater ratio of the back pressure. In these cases the proportion of the pressure applied to the development of power was with Series E 0·699, and with series I 0·635. In making these comparisons throughout all the Series, some discrepancies will be observed; they are to be referred to the leakage of a cut-off valve already noticed, and went of course to vitiate the rate of expansion as given by the actual closing of the valve. From the foregoing, will be appreciated how great is the importance in view, not only of economical but of potential results, to make the exhaustion as low as possible, and to reduce the ratio of the back pressure to the total average pressure to a minimum, by using the highest convenient average pressure throughout the stroke. It shows how easily the gain by cutting off the steam shorter, which with the same initial pressure will give a less average pressure throughout the stroke, can be neutralized by the loss consequent on the necessarily increased ratio of the back pressure, and that to *fully* realize the benefits of increased expansion, it must be accompanied by a corresponding increased initial pressure so as to maintain the same average pressure as before. These remarks are particularly applicable to non-condensing engines, where the atmospheric pressure alone constitutes with any practicable initial steam pressure, a very high ratio of back pressure. A point can soon be reached, beyond which, if expansion be carried, a loss in economy of fuel instead of gain will result; as for example, in Series C and I, both having substantially the same initial steam pressure, by cutting it off in C at 0·348, and in I at 0·152 of the stroke; in these Series the economy of fuel was 1·234 for the long, and 1·358 for the short cut-off, showing that the greater expansion resulted in a greater loss from the causes just mentioned. Practically, economy of fuel depends conjointly on the ratio of



N° 1
10 lbs.
5
Atmospheric Line
N° 2
15 lbs.
10
5
Atmos. Line
N° 3
45 lbs.
40
35
30
25
20
15
10
5
Atmospheric Line
N° 4
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5 Atmospheric Line
N° 5
75 lbs.
70
65
60
55
50
45
40
35
30
25
20
15
10
5 Atmospheric Line
N° 6
80 lbs.
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5 Atmospheric Line

the expansion of the steam and on the ratio of the back pressure to the total average pressure.

INDICATOR DIAGRAMS.

A few specimens of the Indicator Diagrams taken, will be satisfactory to the reader; the following are therefore given, viz:—

No. 1 was taken when the power was employed merely to overcome the friction of the engines and shafting. Number of double strokes of pistons made per minute 18.

No. 2 was taken under precisely the same circumstances as No. 1, except that the steam was entirely shut off from one cylinder, the other cylinder only being used. The number of double strokes of piston made per minute was 36, and the mean effective pressure throughout the stroke is just double that of No. 1.

No. 3 was taken before the old throttle valve was removed; all the valves except the cut-off, which was fastened wide open, were in the same condition as when the diagrams for Series A, B, and F were taken. Steam pressure in boilers, 85 pounds per square inch. Number of double strokes of pistons made per minute was 36.

No. 4 is one of the diagrams taken for Series C.
" 5 " " " I.
" 6 " " " J.
and after the last cut-off had been substituted for the first one.

EVAPORATION BY THE BOILERS.

The evaporation was carefully ascertained in the following manner, viz:—The water in the boilers being at its normal height, was heated until the gauge showed a steam pressure of 85 pounds per square inch above the atmosphere; the fire was then withdrawn from the furnace, and a new fire started with the Lackawana anthracite of the nut size, the lumps averaging about an inch cube; 6000 pounds of this coal were accurately weighed out and regularly fed to the furnace; the fire was managed by the regular fireman exactly the same as in ordinary practice. The coal was entirely consumed in 10 hours 30 minutes, when the remaining ashes, clinkers, and unburnt coal were weighed. The chimney damper was kept wide open. The boilers had been in constant use for several days previous, and the brick-work was thoroughly dry and heated up. The weather was clear, fine, and dry, the thermometer averaging 30° Fah. The boiler pressure was very regularly maintained, the minimum being 78 and the maximum 90 pounds per square inch above the atmosphere. The number of double strokes made per minute by the pistons was very regular throughout the experiment, the minimum being 36 and the maximum 39. The pressure in the cylinders before cutting off was 63 pounds per square inch above the atmosphere for the minimum, and 70 for the maximum. The work performed was grinding with three run of four feet diameter stones, 50·75 bushels of wheat per hour.

The Worthington steam pump for supplying cold condensing water to the condenser, averaged during the experiment 78 double strokes of piston per minute, its throttle being nearly closed. The diameter of the steam cylinder of the pump is 12 inches, stroke of piston 7 inches. Space displacement of piston per stroke, plus clearance and nozzles, 0·48 cubic foot. The final steam pressure in this cylinder averaged, by experiment at the end of the stroke, as nearly as could be ascertained, 24 pounds per square inch, including the atmosphere. The steam used in the Worthington pump will be computed separately.

The temperature of the water overflowing from the condenser averaged 80° Fah. The temperature of the water of condensation in the reservoir averaged 130° Fah. The temperature of the feed water when fed into the boilers averaged 122° Fah. The temperature of the condensing water was 36° Fah.

Indicator diagrams were taken regularly every 20 minutes during the experiment, and the quantity of steam used is computed from the average of the final pressures in the cylinders at the end of the stroke. Each diagram was traced three times by the pencil, and all not agreeing were rejected and new ones taken. The following are the data and results:

DATA.

Total duration of the experiment in hours and minutes, .	10h. 30′
Total number of double strokes of piston made by the engines,	23,310
" " Worthington's steam pump,	49,140
Total number of pounds of Lackawana anthracite, lumps 1 inch cube, put in the furnace, ...	6000
Total number of pounds of ashes, clinkers, and unburnt coal withdrawn from the furnace, ...	1020
Total number of pounds of combustible consumed, . .	4980
Average steam pressure in boilers in pounds per square inch above the atmosphere, ...	81
Average steam pressure in cylinders in pounds per square inch above the atmosphere, before cutting off, ...	66
Average steam pressure in cylinders in pounds per square inch above the atmosphere at end of stroke of pistons, . .	15·8
Steam cut-off at in cylinders from commencement of stroke of pistons, 0·203 or	9·744 ins.
Mean number of double strokes of piston made per minute by engines,	37
Mean number of double strokes of pistons made per minute by the Worthington steam pump, ...	78
Average steam pressure in the steam cylinder of the Worthington pump at end of stroke of piston in pounds per square inch, including the atmosphere, ...	24
Mean number of pounds of coal thrown on the grate per hour, . .	571
" " combustible consumed " . .	474
Mean temperature of the water fed into the boilers, in degrees Fah., .	122°
Mean temperature of the heated gases escaping from the boilers, in degrees Fahrenheit, ...	694°
Mean temperature of the heated gases in the furnace and over the incandescent fuel, in degrees Fah., ...	1750°

RESULTS.

Total number of cubic feet of steam of atmospheric pressure consumed by the engines, ...	913789·800
Total number of cubic feet of steam of atmospheric pressure consumed by the Worthington steam pump, . . .	73982·000
Total number of cubic feet of steam of atmospheric pressure consumed during the experiment, . . .	987771·800
Number of pounds of steam evaporated by one pound of coal, temperature of feed water 122° Fah., . . .	6·052
Number of pounds of steam evaporated by one pound of coal, temperature of feed water 100° Fah., ...	5·925
Number of pounds of steam evaporated by one pound of coal, temperature of feed water 212° Fah., ...	6·635

Number of pounds of steam evaporated by one pound of combustible, temperature of feed water 122° Fah., . . .	7·291
Number of pounds of steam evaporated by one pound of combustible, temperature of feed water 100° Fah., . . .	7·138
Number of pounds of steam evaporated by one pound of combustible, temperature of feed water 212° Fah., . . .	7·994
Number of pounds of coal consumed per hour per square foot of grate surface, ...	9·930
Number of pounds of combustible consumed per hour per square foot of grate surface, ...	8·244
Number of pounds of coal consumed per hour per square foot of heating surface, ...	0·489
Number of pounds of combustible consumed per hour per square foot of heating surface, ...	0·405
Number of pounds of steam evaporated per hour from one square foot of heating surface, ...	2·959
Number of square inches of air space in the grate per pound of coal consumed per hour, ...	3·410
Number of square inches of air space in the grate per pound of combustible consumed per hour, ...	4·110
Number of square inches of cross area of the flues per pound of coal consumed per hour, ...	1·190
Number of square inches of cross area of the flues per pound of combustible consumed per hour, ...	1·430

The above experiment was, for the purpose of confirmation, continued by the consumption of 4000 pounds more of the same coal accurately weighed and regularly fed to the furnace as before. The cut-off was altered so as to cut off shorter, carry a higher pressure, and maintain about the same number of double strokes of piston per minute as before. The temperatures of the feed, condensing and overflow water remained as before; also, the number of double strokes made per minute by the steam piston of the Worthington pump, and the quantity of steam required to supply it. The temperatures of the heated gases in the furnace, and escaping from the boiler, were the same as before. The number of pounds of coal thrown on the grate per hour was the same precisely as before; and this coal, being the same, left precisely the same per centage of ashes, clinker, and unburnt coal. The minimum boiler pressure was 85, and the maximum 102 pounds per square inch above the atmosphere. The steam pressure in the cylinders before cutting off was for minimum 68, and for maximum 80 pounds per square inch above the atmosphere. The minimum number of double strokes of piston made per minute was 38, and the maximum 40. The chimney damper was carried wide open. The duration of the experiment was 7 hours 10 minutes. The work done consisted in grinding wheat with four run of 4 feet diameter stones, at the rate of 46 bushels per hour, the feed on each run of stone having been made considerably lighter than before. Indicator diagrams were taken every 15 minutes, and the quantity of steam used is computed, as in the first experiment, from the average of the final pressures in the cylinders at the end of the stroke of the pistons. Each diagram was thrice traced by the pencil. If the three tracings did not coincide, it was rejected and a new one taken. The steam consumed by the Worthington pump is computed separately and added. The following are the data and results of this the second experiment, to determine the evaporation by the boilers, viz :—

DATA.

Total duration of the experiment in hours and minutes,	7h. 10′
Total number of double strokes of piston made by the engines,	16,598
“ “ “ “ “ Worthington steam pump,	33,540
Total number of pounds of Lackawana anthracite, lumps 1 inch cube, put in the furnace,	4000
Total number of pounds of ashes, clinkers, and unburnt coal withdrawn from the furnace,	680
Total number of pounds of combustible consumed,	3320
Average steam pressure in boilers in pounds per square inch above the atmosphere,	91
Average steam pressure in cylinders in pounds per square inch above the atmosphere before cutting off,	72
Average steam pressure in cylinders in pounds per square inch above the atmosphere at end of stroke of pistons,	13·3
Steam cut off at in cylinders from commencement of stroke of pistons,	0·152 or 7·296 in.
Mean number of double strokes of piston made per minute by engines,	38·6
“ “ “ “ “ the Worthington steam pump,	78
Average steam pressure in the steam cylinder of the Worthington pump at end of stroke of piston in pounds per square inch, including the atmosphere,	24

RESULTS.

Total number of cubic feet of steam of atmospheric pressure consumed by the engines,	601574·300
Total number of cubic feet of steam of atmospheric pressure consumed by the Worthington steam pump,	50495·800
Total number of cubic feet of steam of atmospheric pressure consumed during the experiment,	652070·100
Number of pounds of steam evaporated by one pound of coal, temperature of feed water 122° Fah.,	5·993
Number of pounds of steam evaporated by one pound of coal, temperature of feed water 100° Fah,	5·867
Number of pounds of steam evaporated by one pound of coal, temperature of feed water 212° Fah.,	6·570
Number of pounds of steam evaporated by one pound of combustible, temperature of feed water 122° Fah.,	7·220
Number of pounds of steam evaporated by one pound of combustible, temperature of feed water 100° Fah.,	7·069
Number of pounds of steam evaporated by one pound of combustible, temperature of feed water 212° Fah.,	7·916
Number of pounds of steam evaporated per hour from one square foot of heating surface,	2·861

These results are almost identical with those from the first experiment.

The steam room of the boilers contains 442 cubic feet, and when cutting off at the longest, there was drawn from it only 4 cubic feet of steam per stroke of pistons, or about the 110th part; consequently there could have been but little loss from foaming, especially as the steam was taken out at a height of 6 feet 9 inches above the water level. The covering of the boilers, steam drums, and steam pipes, was so complete that no great loss from radiation could have taken place; this loss could have been sensible from the uncovered cylinders only.

I consider these boilers a very good specimen of their type; they are of sufficient length to retain the heated gases within them for a reasonable time. These gases are first broken up and mixed at the cross boiler, and again when they enter the return flues. The brick bridge walls are judiciously shaped, and the calorimeter well proportioned. The air spaces between the grate bars, and the grate bars are very narrow; the amount of coal burned per square foot of grate per hour is moderate, and the ratio of the heating to the grate surface, without being large, is considerable. In view of all the above conditions, I am disposed to consider the evaporation obtained as a maximum for this type of boiler.

I endeavored to obtain the temperature of the heated gases at their exit from the flues, but a mercurial thermometer graduated to 570° Fah., which was used for that purpose, broke by the expansion of the mercury within, after it had reached that temperature. I now resorted to sheet lead, and placed at the mouth of the flues a small roll of that metal supported on a fire brick; it melted at once and ran down like water; this experiment, repeated a number of times, at intervals, and with different flues, gave always the same result. I then tried zinc in the same manner; this metal was not in the least fused by the heat, the edges and filaments of the fractured parts remaining as sharp and distinct as when first placed at the mouth of the flue. I now placed, immediately after a fresh charge of coal had been thrown on the grates, a roll of sheet lead having a portion cut into fine fragments at the junction of the sheet iron conduit and the brick chimney; this conduit is 10 feet long, and connects the mouths of the flues with the chimney. The fine fragments of lead soon fused and ran together, but the large mass of the lead did not thoroughly melt until the fires were at their maximum. The melting point of lead is, according to Morveau, 593°·6 Fah.; according to Dalton 611°·6 Fah.; according to Rudburg 617° Fah., and according to Kupffer 633°·2 Fah.; the mean of these authorities is 614° Fah. The melting point of zinc is, according to the accurate experiments of Daniell, 774° Fah. The temperature of the heated gases at their exit from the flues lay, therefore, between these numbers; perhaps we shall nearly approach the truth by the mean, and may consider the temperature to have been

$$\left(\frac{614+774}{2}=\right) 694^\circ \text{ Fah.}$$

I endeavored to obtain the temperature of the heated gases in the furnace immediately over the incandescent fuel, in the following manner, viz: I took a thin round piece of silver and bent it nearly double, and placed it on a fire brick so that it touched the brick but at two points, and exposed both sides of the silver to the action of the heat. The furnace having been freshly fired-up, the brick with the silver on it was placed in the centre, and at about one-third the length of the furnace from the bridge wall; it was allowed to remain a considerable time, and until the furnace required firing again, when it was withdrawn, and was found to be sunk down flat and fused on the surface, but not thoroughly melted throughout. A roll of fine copper wire was next tried in the same manner, but on being withdrawn after a considerable time exhibited no marks of fusion. The melting point of silver is, according to Prinsep, 1830°·2 Fah.; according to Pouillet, 1832° Fah.; and according to Morveau, 1893°·2 Fah.; the mean of these numbers is 1852° Fah., and as the temperature of a steam boiler furnace fluctuates about 200° Fah., we shall probably be not far from the truth if we take 1750° Fah. for the mean temperature of the furnace.

In the September number of this *Journal*, 1854, pages 196 and 197, it has been shown by the writer, that the heating power of coal is practically in the direct ratio of the carbon they contain; and that the total theoretical evaporation possible by one pound of carbon, supposing no heat to be lost by radiation, or in producing the draft, or in any other manner, and that the entire amount of heat developed by the combustion was applied to the evaporation, is 14·624 pounds of water from the temperature of 212° Fah. Also, that the composition of Pennsylvania anthracite is, according to the ultimate analysis of Richardson, and exclusive of earthy matter, as follows, viz: oxygen, 2·56 per centum; hydrogen, 2·55 per centum; and carbon, 94·89 per centum. Hence, the absolute theoretic evaporation by our coal will be $(14{\cdot}624 \times 0{\cdot}9489 =)$ 13·877 pounds of water per pound of coal consumed after deducting the ashes, clinkers, &c. Now, the coal consumed in the experiments, after deducting ashes, clinkers, &c., evaporated per pound 7·994 and 7·916, mean 7·955 pounds of water from 212° Fah., leaving $(13{\cdot}877 - 7{\cdot}955 =)$ 5·922 pounds to be accounted for. The temperature of the heated gases when in the furnace being 1750° Fah., and when leaving the boiler 694° Fah., there would be expended in producing the draft $\left(\frac{694 \times 100}{1750} =\right)$ 39·66 per centum of the total heat, equivalent to an evaporation of $(13{\cdot}877 \times 0{\cdot}3966 =)$ 5·504 pounds of water from 212° Fah., leaving $(5{\cdot}922 - 5{\cdot}504 =)$ 0·418 pounds for radiation, &c.

When the quantity of air entering the furnaces, the composition of the coal, and the temperature of the heated gases escaping from the boiler are known, the per centage of the total heat developed by the combustion, which is lost by the heated gases passing into the chimney and producing the draft, can be calculated. That loss varies not only with the temperature of the escaping heated gases, but also with the *quantity of air entering the furnace.* Let us take the case where only the exact quantity of atmospheric air enters the furnace, which is required for the perfect combustion of the coal of our experiments. Referring again to page 197 of the September, 1854, number of this *Journal*, it is there shown that the total calorific power of 1·00 unit of weight of carbon—the sole heat-producing constituent—is capable of heating 75·094 units of weight of water from the freezing to the boiling point, or of giving out $(75{\cdot}094 \times (212 - 32) =)$ 13668 units of heat. The products of the combustion of one pound of our coal, after deducting ashes and clinkers, amount to 12·8 pounds of gases, the mean density of which differs but little from that of atmospheric air. The specific heat of this mixture of gases is also about that of the atmospheric air, and the specific heat of the latter is one-fourth that of water; consequently one pound of carbon will raise one pound of the gases through $(13668 \times 4 =)$ 54672° Fah.; but this heat if diffused among 12·8 pounds, the temperature will therefore be $\left(\frac{54672}{12{\cdot}8} =\right)$ 4271° Fah. This, however, is on the supposition that no more air has entered the furnace than is rigorously required for the combustion; if a greater weight of air enter, the temperature will of course be reduced in that proportion. Now we have seen that the temperature of our furnace was experimentally 1750° Fah., therefore the weight of gases passing from the furnace was $\left(\frac{4271}{1750}=\right)$ 2·44 times greater than it should have been, or instead of being 12·8 pounds it was $(12{\cdot}8\times 2{\cdot}44=)$ 31·23 pounds, of which the original fuel constituted one pound, leaving 30·23 pounds of atmospheric air to have entered instead of $(12{\cdot}8-1{\cdot}0=)$ 11·8 pounds, or $\left(\frac{30{\cdot}23}{11{\cdot}8}=\right)$ 2·56 times more air than necessary. The 2·56 times more air than what was rigorously required for combustion, which passed through the grates, shows there was no lack of oxygen to render the combustion perfect; it also shows that the grate surface was too large for obtaining the highest economical result from the fuel, because with the given draft and weight of coal consumed, it admitted 2·56 times more air than necessary, and involved a loss of caloric represented by this weight of air multiplied by the difference of its temperature when entering and leaving the boiler. The fuel was kept about 7 inches thick on the grates; now had the latter been reduced from 5 to 3 feet in length, and the fuel kept about 12 inches deep on the grates, it is evident that a considerably higher economical result would have been attained, and that about the same weight of fuel would have been consumed as before. It is a fact well known to engineers, that a reduction of grate surface in a given boiler is very frequently productive of the most satisfactory results. This will particularly follow in boilers where a strong draft obtained by height of chimney is joined to a moderate consumption of coal per square foot of grates per hour. Had no more air entered the furnace than what was rigorously required for the combustion of the fuel, and supposing also the combustion to have been perfect, the loss of heat by the gases entering the chimney at 694° Fah., would have been only $\left(\frac{694\times 100}{4271}=\right)$ 16·25 per centum, instead of 39·66 per centum, as was actually the fact.

From the foregoing data, the velocity with which the heated gases leave the furnace can be computed. These gases have about the same mean density as dry atmospheric air, which weighs 0·076555 pounds avoirdupois per cubic foot at the standard of 60° Fah., and 30 inches barometer. There was consumed of combustible during the experiment 474 pounds per hour, and we have seen that the products of the combustion and the additional air which entered the furnace, amounted to 31·23 pounds per pound of combustible, or to $\left(\frac{31{\cdot}23\times 474}{60}=\right)$ 246·717 pounds per minute, equal to $\left(\frac{246{\cdot}717}{0{\cdot}076555}=\right)$ 3222·74 cubic feet per minute at standard temperature and pressure. But these gases in the furnace had a temperature of 1750°, or $(1750-60=)$ 1690° higher than the standard, and as gases expand 0·3667 for every 180° Fah., the 3222·74 cubic feet will become in the furnace 14318·31 cubic feet. The area between the top of the bridge wall and the bottoms of the boilers is

6·415 square feet, consequently to pass 14318·31 cubic feet of gases, the velocity per minute must have been $\left(\frac{14318·31}{6·415}=\right)$ 2232 feet, or 37·2 feet per second. This velocity, however, is not maintained; it decreases if the same cross-section of flue be preserved, in the ratio that the gases decrease in bulk from loss of temperature, becoming slower and slower as they approach their exit. The temperature of the gases at the mouth of the flues where they enter the chimney, was 694° Fah., or (694—60=) 634° above the standard temperature; the expansion of the gases due to this temperature would increase the original bulk of 3222·74 cubic feet at standard temperature, to 7385·23 cubic feet, and as the cross area of the flues is 4·712 square feet, the velocity of the gases per minute when they enter the chimney would be $\left(\frac{7385·23}{4·712}=\right)$ 1567·32 feet, or 26·1 feet per second.

The large boilers are 10 years old, and have been nearly in constant operation day and night during the whole of that period. They have during that time been twice repaired, when particular plates of the iron have been found deeply honey-combed, while others adjoining were nearly as sound as ever; about the honey-combed portions salts of copper were found, carried there from the copper pipes of the condenser. The present cross-boiler is the third that has been put in entirely new during the 10 years; the destruction here is much more rapid, and the salts of copper are found in much greater quantities. It will be remembered that the feed water is pumped directly from the copper condenser through copper feed pipes into the cross-boiler. Pure water is used in the boilers, and any deficiency of the distilled water furnished by the condenser, is supplied by rain water; on an average, 600 pounds of rain water are required per 24 hours steaming. The condenser has been used 9 years in connexion with these boilers.

Efficiency of the Condenser.

The condenser is 9 years old, and has been, with occasional short intervals, in constant use day and night. During these 9 years the upper two "gridirons" have been renewed once; the lower three "gridirons" are the same as originally put in. The upper gridiron first receives the exhaust steam as it leaves the cylinders, consequently the heat is there the greatest as well as the washing off of the salts of copper by the rush of the steam current; this portion therefore goes first, and the wasting of the metal appears on close examination to have taken place about equally on *both* sides the copper; that is to say, on both the sea water and distilled water sides. The weight of copper in the condenser is 885 pounds. When working ordinarily, that is to say, receiving about 97,000 cubic feet of steam of atmospheric pressure per hour, equal to 3566 pounds of water; there are required to be added to the boilers per hour about 25 pounds of water, the loss is consequently $\left(\frac{25\times100}{3566}=\right)$ ·7 of 1 per centum; that is to say, all the steam received by the condenser, less ·7 of 1 per centum, is returned to the boilers in the state of distilled water at the temperature of 130° Fah. in the reservoir, and

122° Fah. when entering the boilers. This loss of ·7 of 1 per centum may be considered as due entirely to leakage.

The space displacement of the pump piston for supplying the condenser with cold water, is 0·156 cubic foot per stroke, and allowing it to discharge two-thirds of its capacity of water, it will, at its average speed of 78 double strokes of piston per minute, discharge 973·44 cubic feet of water, or 60,840 pounds of water per hour, which gives for condensing each pound of steam of atmospheric pressure to water of 130° Fah., $\left(\frac{60840}{3566}=\right)$ 17 pounds of water. The temperature of the condensing water was 36° Fah.; temperature of the water overflowing from the condenser was 80° Fah.; it had gained, therefore, only (80—36=) 44° of temperature, and was still (130°—80°=) 50° Fah. below the temperature of the condensed steam. The weight of condensing water at 36° Fah. required to condense a pound of steam of atmospheric pressure so that the temperature of the mixture shall be 130° Fah., will be, taking the total heat of steam of atmospheric pressure at 1146°·6 Fah., $\left(\frac{1146{\cdot}6-130}{130-36}=\right)$ 10·81 pounds. The weight required with the surface condenser, we have seen to be 17 pounds.

No mechanical provision was made for the distribution of the cold water and steam among the pipes, both currents being allowed to take their own routes from their places of entrance to those of exit. In view of this fact, and of the small amount of surface contained in the condenser proportionably to the quantity of steam to be condensed, viz: only 304 sq. feet to condense 1616$\frac{2}{3}$ cubic feet of steam of atmospheric pressure per minute, or 1 sq. foot of surface per 5·32 cubic feet of steam, using only $\left(\frac{(17\cdot-10{\cdot}81)\times 100}{10{\cdot}81}=\right)$ 57·3 per centum more than the theoretic quantity of condensing water. I consider the result obtained, which is the condensation of all the steam entering, and its return minus the ·7 of 1 per centum loss by leakage, to the boilers in the shape of distilled water, as very remarkable. The number of years the condenser has been in operation, and the uniform satisfaction it has always given, must not be overlooked in making up an opinion on this description of instrument.

AMERICAN PATENTS.

List of American Patents which issued from April 7th, to April 21st, 1857. (*inclusive,*) *with Exemplifications.*

APRIL 7.

1. For an *Improvement in Harvesters;* Samuel S. Allen, Bristol, Pennsylvania.

Claim.—"The combination of the upper platform and sliding pole, with the main frame and inclined draft rod or chain, when the same are constructed and arranged for joint operation."

2. For an *Improved Mode of Clinching Spikes;* Horatio Bates, City of New York.

Claim.—"Securing a spike or nail by boring a hole in the timber of less depth than the spike or nail itself to receive it, and inserting thereinto, before the spike or nail, a ball or lump of metal of substantially similar character, to deflect the point thereof when it is driven, and thereby cause it to clinch itself."

3. For an *Improvement in Steam Boilers;* Smith Baldwin, St. Louis, Missouri.

Claim.—"The arrangement of the cylinders, the water tubes, flues."

4. For an *Improvement in Window Curtain Fixtures;* Ransom Ballou, Jr., and Benjamin F. Hooper, Albany, New York.

Claim.—"A tightening button or pulley, affixed at or near the circumference of a rotating disk or barrel, the said disk being combined either with the pawl and fixed ratchet, or with other means within it for maintaining the necessary stress upon the cord."

5. For an *Improvement in Processes for Treating Moss for Matresses;* Samuel Baker, City of New York.

Claim.—"The method of treating or preparing the moss of commerce to serve as a substitute for curled animal hair."

6. For an *Improved Apparatus for Exhibiting Stereoscopic Pictures;* Alexander Beckers, City of New York.

Claim.—"1st, Arranging the pictures at right angles to the endless belt. 2d, The mode of securing the pictures in the grooved slides, by means of the elastic bands and notches in the ends of the grooved portions of the slides."

7. For an *Improved Road Scraper;* Chauncey Blakeslee, Ashtabula, Ohio.

Claim.—"The grading blade, arranged and combined with the runners, with the draft forward of the edge of the blade, for the purpose of causing said runners to serve as guides or gauges thereto, and preventing the blade from dropping into furrows or depressions."

8. For an *Improved Shingle Machine;* John L. Brown, Indianapolis, Indiana.

Claim.—"The construction of a self-feeding shingle machine, by the arrangement and combination of the wheel upon the shaft, the wheel, the eccentric, the lever, the bolt, and the oscillating table."

9. For an *Improvement in Hoisting Winches for Ship Board;* Joel Bryant, Brooklyn, New York.

Claim.—"The construction and use of windlasses or winches, having a sheave pulley or wheel set on the axle of said windlasses or winches back of their boss or head, and connecting and operating with other sheaves or pulleys, operated by the said windlasses or winches, or by the tackle connecting therewith, for hoisting the sails of vessels, and for such like purposes."

10. For an *Improvement in Folding Window Blinds;* Sylvanus S. Clark, Manchester, New Hampshire.

Claim.—"1st, The employment of movable upright pieces containing notches to receive and constitute bearings for the tenons of the blind slats, arranged to operate within the stationary sides of the blind or shutter framing, for the purpose of confining the tenons of the slats when the blind or shutter is down, or of liberating the tenons to allow the blind or shutter to be drawn up or folded. 2d, The guide plates for conducting the tenons of the bottom slat clear of the notches during the drawing up of the blind, such plates being attached to portions of the tenons of the said slat that extend beyond the ends of the tenons of the other slats, into cavities that are made within the stationary side pieces of the blind, for the cords or chains by which the blind is raised or folded to work through. 3d, The construction of the chains with stops on the links, arranged in such manner as to allow the links to fold freely inwards or away from the slats, and prevent them folding between the slats. 4th, The application of the spring and cord to the upper slat, in combination with the connexion of the slats by the chains at their inner edges, for the purpose of effecting the closing of the slats when the blind or shutter is down, and keeping them closed unless held open by other means. 5th, The suspension of the top slat from fixed pins in the cap of the frame of the blind or shutter, by slotted plates, which admits of all the movements. 6th, The curved lever and sliding ratchet bar, applied to operate upon the lower slat, and open the blind or shutter from the interior of the window. 7th, The hook attached to the inner edge of one of the slats, and operating in combination with the spring and cord, to hold open the slats of the upper portion of the blind or shutter, while the lower portion remains closed."

11. For an *Improved Machine for Making Rivets;* Richard H. Cole, St. Louis, Mo.

Claim.—"1st, Forming a successive series of die boxes of a double series of sections, which are combined with the parallel peripheries of two equal sized intermittingly rotating wheels, when the arrangement of the bearings of one or both of said wheels is such as to allow of a sufficient amount of lateral play thereof, to enable a pair of said sections to be firmly pressed against each other at the termination of each intermittently rotary movement of said wheels. 2d, Combining the curved gauge plate and the cutting plate with each other, and also with the cam wheels. 3d, The combination of the cam wheels with the gauge plate, the cutting plate, and the header."

12. For an *Improved Cutting Apparatus for Harvesters;* Samuel Comfort, Jr., Morrisville, Pennsylvania.

Claim.—"As an improvement on the cutting apparatus of harvesters, for which a patent was granted me on the 18th day of March, 1856, the springs with their twisted or bent projections, in combination with the endless chain of cutters and stationary knives."

13. For an *Improvement in Reefing Sails;* Washington F. Davis, Winthrop, Mass.

Claim.—"Arranging the ranges of folding eyes or grummets, and the reefing lines above the reef band, or with respect to the upper yard, in order that the sail, when reefed, shall at the same time be folded or plaited against the upper yards. Also, the arrangement of the lines of grummets or eyes at unequal distances apart, in order that the minor part of each fold of the sail may come underneath the yard, or the yard project beyond it when the sail is reefed."

14. For an *Improvement in the construction of Baskets;* Joel A. H. Ellis, Springfield, Vermont.

Claim.—"The new and improved manufacture of basket as made of vertical splints, two bottom boards, top hoops, and staple connexions, or their equivalents. Also, the arrangement of the staple connexions, viz: so that each one shall lap on the two next adjacent it, the same causing the fibres of the wood of the splint to be drawn together by the strain of the load of the basket."

15. For an *Improvement in Reaping Machines;* George Esterly, Heart Prairie, Wis.

Claim.—"The combination of the common supporting beam, with an adjustable raker's seat or stand and platform, when said parts are constructed and arranged in relation to each other, so as to be easily adjusted to any desired position, and there firmly held while the machine is in operation, and the raker on the platform."

16. For an *Improvement in Forming Spiral Springs for Chairs, Sofas, and other articles;* John T. Foster and Jacob J. Banta, Jersey City, N. J., and James H. Banta, Piermont, New York.

Claim.—"The spirally cut metallic plate spring, applied to sofas, chairs, and similar articles."

17. For an *Improvement in Machines for Felting Hat Bodies;* Wm. Fuzzard, Cambridgeport, Massachusetts.

"My invention relates to an improvement in a felting machine formerly patented by me, and which consisted of an apron attached to a drum, and working between two pressure rollers fitting in a swinging or vibrating frame, the article to be felted being placed on the lower part of the apron."

Claim.—"The employment or use of the roller, one or more attached or applied to the machine."

18. For an *Improvement in Rotary Pumps;* Richard Gilbert, Rochester, N. Y.

"The nature of my invention consist in combining with the annular piston of rotary pumps, a vibrating link, which combination is found to work much easier, and much more perfectly than that of the annular piston and radial arm."

Claim.—"The vibrating link (or arm), in combination with the annular piston."

19. For an *Improved Current and Paddle Wheel;* James H. Hanchett, Beloit, Wis.

Claim.—"1st, Suspending water and paddle wheels, by means of radius bars. 2d, The method of maintaining the planes of the faces of the floats of wheels that oscillate in a determinate relation to the radius of oscillation of the wheel."

20. For an *Improvement in Machines for Cutting Fringes;* Wm. J. Horstmann, Philadelphia, Pennsylvania.

Claim.—"The combination of the circular cutters and the feeding rollers."

21. For an *Improved Gate Post attachable to any Panel of its corresponding Field Fences;* James G. Hunt, Cincinnati, Ohio.

Claim.—"The application of a portable post to a fence, whether portable or permanent, for the purpose of hanging or fastening thereon a gate."

22. For an *Improvement in Photographic Trays;* Daniel J. Kellogg, Rochester, New York.

Claim.—"The employment of the movable bottom."

23. For an *Improvement in Smut Machines;* Israel Kepler, Milton, Penna.

Claim.—"In the construction of the stave, the horizontal ribs, and openings, when said ribs are cut away on their inner faces, so as to facilitate and concentrate the blast of air that is to pass through them, to carry off the smut and other impurities."

24. For an *Improvement in Lamp Burners;* A. M. Knapp, Medford, Massachusetts.

Claim.—"The arrangement in a movable burner so that it may be applied to a common glass lamp of the perforated screen apertures, small column and cam, provided with an eccentric slot, whereby I am enabled to produce a steady and even flame."

25. For an *Improved Arrangement of Staging Brackets;* Joseph C. Latham, Phœnixville, Connecticut.

Claim.—"The use or employment of the bracket, the strap, and dog."

26. For an *Improved Liquid Metre;* Otto G. Leopold, Cincinnati, Ohio.

Claim.—"1st, Suspending the wheel or drum, and floating it so as to reduce the friction of its bearing to the smallest possible amount, and thus, in addition to the other means rendering it peculiarly adaptable to the registering of the flow of liquids. 2d The arrangement of dividing the inlet opening into an appropriate number of small apertures so as to protect the wheel from the gross impurities of the water, and thus preventing its free motion from being disturbed."

27. For an *Improvement in Harvesters;* Pells Manny, Waddam's Grove, Illinois.

Claim.—"The combination of the smooth elastic metal cap or sheath, connecting the divider with the main wing, with the reversed hook or bent projecting end of an automatic rake, when said parts are constructed and arranged for joint operation."

28. For an *Improvement in Harvesters;* Pells Manny, Waddam's Grove, Illinois.

Claim.—"Raising and lowering the finger bar of harvesters, by means of the adjusting staunchion, when used in combination with the elastic shoe, rigidly attached to the draft bar or pole, and jointed to the main frame in front of the driving wheel, and back of the finger bar."

29. For an *Improved Arrangement of Carriage Springs;* Rinehart P. March, Jeffersonville, Pennsylvania.

Claim.—"The arrangement of the combination spring, axle, slotted bar, and guide pin, for the purpose of supporting the spring and preventing lateral strain, and for making of equal strength a much cheaper and lighter carriage than usual."

30. For an *Improvement in Securing the Legs of Sectional Corn and Cob Mills;* Richard F. Maynard, Baltimore, Maryland.

Claim.—"The mode of securing the legs and the parts of the concave together."

31. For an *Improvement in Corn and Cob Mill;* Richard F. Maynard, Baltimore, Md.

Claim.—"The arrangement of the teeth so as to break points, and to form a series of interrupted screw threads by their inclined points."

32. For an *Improvement in Window Curtain Fixtures;* Purches Miles, Hartford, Connecticut.

Claim.—"The arrangement of the springs for the three-fold purpose of keeping the band in place, supporting the shade at any required height, and preventing the roller from having end play."

33. For an *Improvement in Sound Boards of Piano-Fortes;* Joseph Newman, Baltimore, Maryland.

Claim.—"In piano-fortes and other musical instruments having two or more sounding boards, making the bridges upon the lower sounding board or boards to protrude through, or rise beyond, the sounding board or boards above them."

34. For an *Improved Trimming Jack;* Garret J. Olendorf and Edwin R. Tripp, Middlefield, and Samuel Harper, Cooperstown, New York.

Claim.—"The construction of shaft, in connexion with frame and lever operating the dies."

35. For an *Improvement in Hawser Holes for Vessels, &c.;* Jason C. Osgood, Troy, New York.

Claim.—"Beveling the edges of the pulleys."

36. For an *Improvement in Machines for Paring Apples;* J. J. Parker, Marietta, O.

Claim.—"The combination of a spring holder with the knife arm."

37. For an *Improvement in Paper Ruling Machines;* Charles L. Pond, Buffalo, New York.

Claim.—"The spring connected box and shaft, combined with the stop wheel and the detachable rim."

38. For an *Improvement in Strings for Musical Instruments;* William Randle, Florida, New York.

"The nature of my invention consists in providing for each string one or more springs, to prevent the strings from breaking when exposed to the dampness of the atmosphere, or other causes which will contract the strings and cause them to break, which is often the case with the ordinary mode of construction."

Claim.—"The application of one or more springs applied to each string, or its equivalent."

39. For an *Improved Field Fence;* Samuel Rains, Lancaster County, Virginia.

Claim.—"The making of a fence without posts when the panels are fastened together."

40. For an *Improved Wrench;* Ezra Ripley, Troy, New York.

Claim.—"Making the levers combined together with wrench jaws so arranged that the levers do not tend to spread open when used as an adjustable wrench."

41. For an *Improved Mode of arranging and operating Window Shutters;* D. Rohan, Cincinnati, Ohio.

Claim.—"Attaching the lower end of the shutter to the slide, or its equivalent, which is fitted in the box below the sill of the window casing, the bars being used in connexion with the slide, and connected at the proper time to the slide by the catches which are actuated by the weights and blocks."

42. For an *Improved Gold Separator;* Edward L. Seymour, City of New York.

Claim.—"The use of the sections or frames when perforated or constructed so as to open or shut the communication between the upright tubes or compartments, for the passage of materials containing gold or other substances of air, or of water, as may be required, the whole operating in connexion with the hopper."

43. For an *Improvement in Veterinary Syringes;* William Somerville, Buffalo, N. Y.

"My invention consists in providing the plunger with a spring and catch, by which the efficiency of the instrument is much increased."

Claim.—"Providing the syringe with the spring and catch, or their equivalents."

44. For an *Improved Machine for Manufacturing Cylindrical Boxes;* Horace S. Smith, Elijah Hinson, and M. S. Richardson, Rutland, Vermont.

Claim.—"The cutters attached to, or formed on, the semi-cylindrical shell, the cutters attached to the ends of the solid semi-cylindrical projection, and the cutter attached to the inner end of the semi-cylindrical projection. Also, in combination with the cutters, the saw attached to the swinging bar."

45. For an *Improvement in Ships' Steering Apparatus;* Samuel N. Smith, City of New York.

"This invention relates to that description of steering apparatus in which the rudder is turned by means of a curved rack and pinion, the pinion being located upon the wheel shaft."

Claim.—"Locating both of the bearings of the wheel shaft upon the tiller. Also, locating the brake upon the tiller and wheel shafts."

46. For an *Improved Road Scraper;* George W. Thomas, Wickford, Rhode Island.

Claim.—"The adjustable side scrapers, in combination with the front release scrapers, when so arranged as to throw the dirt inwardly towards the centre of the road, and in a crowning form, for the purpose of giving a natural drainage to the road."

47. For an *Improvement in Railroad Car Brakes;* Robert M. Wade, Wadesville, Virginia.

"The character of brake to which my invention applies, is that in which the breaking action is effected by the strength of a spring: the invention consists both in the manner of applying the rubbers to the wheels, and withdrawing the same."

Claim.—"The wedge, lever, and bar, constructed, arranged, and operating in combination with the rack. Also, the aforesaid wedge, lever, and bar, in combination with the slack chain for effecting the simultaneous application of the brake rubbers throughout the train."

48. For an *Improvement in Machinery for Making Rope;* Milton Wallwork, Hoosick Falls, New York.

"This invention relates to that description of rope making machine generally known as the sun and planet machine, and consists in certain means of controlling the speed of the strand flyers for the purpose of enabling the twist of the strands to be varied with facility."

Claim.—"The construction of the stationary circle or ring with which the rollers on the flyers run in contact to produce the rotary motion that gives the twist of a series of segments, one or more of which may be removed or withdrawn from the ring or circle or replaced therein at pleasure, for the purpose of varying the twist."

49. For an *Improvement in Fixtures for Curtain Rollers;* C. H. Wheeler, Boston, Massachusetts.

"The object of my invention is to produce a fixture that can be applied to curtains when hung inside of the bead that confines the sash in place, and that shall operate without the use of springs."

Claim.—"Perforating the block in which the curtain rod revolves, so that it may be slipped back upon the pivot, and securing it to the bracket by the dove-tailed ears."

50. For an *Improvement in Printers' Composing Sticks;* Daniel Winder, Cincinnati, Ohio.

Claim.—"The combination and arrangement of the several parts of the composing stick, as constructed with each other."

51. For an *Improved Invalid Chair;* Ransom Witherell, Huntington, Mass.

Claim.—"Attaching the bars to one end of the bars by a joint, and attaching the bars in a similar manner to the opposite ends of the bars, the bars with their cross piece forming the back of the chair, and the bars with their rounds the foot rest, the bars being pivoted to the opposite sides of the stationary chair seat, and perfectly balanced on their pivots."

52. For an *Improved Method of Working Pumps;* William Wright, Hartford, Conn.

Claim.—"The arrangement for working a double bucket pump, consisting of a cam placed centrally over said pump, combined with the buckets thereof, by bell cranks, so situated that one arm of each of said cranks bears at the same time upon opposite or nearly opposite points of the edge of the cam, whereby the necessary strength and stability may be given to the several parts, while preserving the regular throw of the buckets."

53. For an *Improved Method of Constructing Iron Fences;* William S. Fuller, Millburg, Assignor to Wm. D. Cutler, Worcester, Massachusetts.

Claim.—"The manner of connecting the pieces and rods together, by means of the lugs and collars."

54. For an *Improved Construction of a Retort;* Alfred Monnier, Camden, New Jersey, Assignor to self and Isaac Gattman, Philadelphia, Pennsylvania.

Claim.—"The method of preventing the rapid destruction of retorts by placing the same within a fire-clay casing, and packing the space intervening between the retort and said casing with any substance or mixture of substances incapable of combining when heated either with the clay or metal retort."

55. For an *Improved Car Lock;* Henry Ritchie, Assignor to self, Samuel C. Thompson, and George W. Westerfield, Newark, New Jersey.

Claim.—"The combination of the sliding plate, tumblers, and jaws, arranged and operating in connexion with the bolt for releasing the hasp."

56. For an *Improved Machine for Splitting Hoop-Poles;* Joseph and Sylvester Sawyer, Fitchburg, Mass., Assignors to The American Hoop Machine Co.

Claim.—"Moving the knife back from the rolls in proportion as the latter are separated from each other. Also, connecting the knife with the centre of the shaft of the movable feed roll by means of the arm. Also, the friction rolls in the knife stock."

57. For an *Improvement in Hemp Brakes;* James Barkley, St. Louis, Missouri.

"The nature of my invention consists in a hinged platform, so arranged and constructed with suitable attachments as to graduate the speed and sweep of stroke of the brake at the proper time, by the natural traveling motion of the workman or operator upon said platform, thus making the weight of the operator the medium through which the operation of the brake is regulated, leaving the hands entirely free to handle the stock."

Claim.—"The hinged platform, arranged in combination with the mechanism, and so that the attendant upon the platform may change the speed and stroke by merely changing his position, and thus leave his hands at liberty to manage the hemp."

58. For an *Improvement in Propellers;* Robert Griffiths, London, England; patented in England Sept. 13, 1849.

Claim.—"Making propellers with an enlarged boss on the shaft to which the blades are secured, extending say to about one-third of the entire diameter, and this I claim in contradistinction to the solid hub of a diameter merely sufficient for strength as heretofore employed, whereby I avoid the centrifugal or broken action of the water near the centre, which is known to be prejudicial to the propelling action of the blades, and by which also I avoid the resistance due to the action of the blades near the centre, where they otherwise would be in a plane nearly coincident with the plane of the axis of the shaft. Also, in combination with an enlarged boss, the method of connecting the blades therewith, by means of a shank or stem on the blades fitted to, and capable of being turned in the said boss to adjust the pitch of the blades. Also, the adjustment of the pitch of the propeller, by the connexion of the propeller blades with the enlarged hollow boss or hub, and the self-adjusting apparatus. Also, in combination with the enlarged hollow boss or hub, the blades narrowed towards their outer ends, and the round shank attachment to the hub."

59. For an *Improved Mill for Cleaning Castings;* Henry R. Remsen, Assignor to self and W. J. Noyes, Albany, New York.

Claim.—"The use in a horizontal revolving mill for cleaning castings or hollow ware of open work, lattice or grated partitions, parallel to, or in line with, the axle."

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60. For an *Improved Boring Machine;* Jonas Rosenbury, Cherryville, New Jersey.

Claim.—"The arrangement of devices."

61. For an *Improved Cooler for Wine, Beer, and other Liquids in Barrels;* John F. Bergin, Northumberland, Pennsylvania.

Claim.—"Arranging the two cylinders eccentrically in respect to each other, when the widest portion of the chamber is directly below the opening."

62. For an *Improvement in School Slates;* Samuel R. Burrell, City of New York.

Claim.—"The application of a permanent or fixed pile, and also a movable pile, to the ordinary slate frame of commerce."

63. For an *Improvement in Machinery for Crossing the Fibres of Wool in making Felt Cloth;* Thomas B. Butler, Norwalk, Connecticut.

Claim.—"The arrangement and use of regular polygon heads, cams, guide plates, and traversing rods, connected with and operated by the shaft."

64. For an *Improved Preparation of Sugar called Table Manna;* Merano Butterfield, Indianapolis, Indiana.

Claim.—"The use of the sulphate of alumina and potassa, or its equivalent, in the manufacture from white sugar of a substitute for honey."

65. For an *Improvement in Hot-Air Furnaces;* John H. Cahill, Philadelphia, Penna.

Claim.—"The clean-out holes in the lower radiator, in combination with the short stopper tubes, fitting adjustably within the same, and opening through the lower plate of the radiator."

66. For an *Improvement in Levels or Inclinometers;* Thomas A. Chandler, Rockford, Illinois.

Claim.—"The combination of an entire graduated circle, provided with a pendulum and index, with the two parallel sides of the level stock, whereby I am enabled to apply either side of said stock to the surface whose direction is to be ascertained, and at the same time have the index facing the operator, in whatever position he may be placed. Also, the level composed of the before enumerated parts in combination, whereby, among other things, either edge of the instrument may be used uppermost with its face or dial towards the operator, and when any two of the pointers are screened from sight by an intervening body, the third will indicate the inclination of the surface to which the instrument is applied, and the angles at the head and foot of a rafter will be indicated at the same time."

67. For an *Improvement in Lifting Jack;* John S. Chesnut, Philadelphia, Penna.

Claim.—"In combination with the rack lever and the bracket, the thumb lever, so that the user may, with one and the same hand, work the jack, and throw the bracket in and out of gear with the rack at pleasure."

68. For an *Improvement in Raking Attachments for Harvesters;* Isaac H. Conklin, Rockford, Illinois.

Claim.—"Operating the hopper attached to the shaft, by means of the pin on the plate, in combination with the pinions on the shaft, when the said parts are constructed and arranged in relation to the platform."

69. For an *Improved Machine for Sawing Shingles;* Jonathan Creager, Cincinnati, Ohio.

Claim.—"The combination of the bench, working rest, and adjustable stops, with circular saw fed transversely of the shingle by treadle, and cutting longitudinally."

70. For an *Improvement in Lifting Jack;* Robert W. and Daniel Davis, Yellow Springs, Ohio.

Claim.—"The application of the power centrally beneath the self-clutching gripe or collar, whereby its action is directed in the line of the axis of the ratch bar. Also, the free upright connecting rods upon which the reciprocating gripe rests, arranged and operating in combination with said gripe and the lever."

71. For an *Improved Apparatus for Filtering Liquids;* Benjamin N. De Buffon, Paris, France; patented in France May 3, 1856.

"My invention consists in the employment of a cylindrical tube of iron, or other suitable metal, surrounded by a cylinder of wire gauze, containing charcoal or other filtering material."

Claim.—"1st, The general arrangement and construction of tritular apparatus for filtering water and other liquids. 2d, The mode of constructing stationary and tubular filters, in which the impure water to be clarified is passed from the exterior to the interior of the filter. 3d, The compressing of the filtering material."

72. For an *Improvement in Machinery for Manufacturing India Rubber Hose;* Thomas B. De Forest, Birmingham, Connecticut.

Claim.—" 1st, The employment of a pressure roller or rollers, of a length equal to a comparatively small portion of the length of the mandrel, when such roller or rollers or the mandrel have a longitudinal movement. 2d, Giving the mandrel a rotary motion independently of the pressure rollers, and causing the latter to derive motion from the mandrel. 3d, Making the pressure rollers of a tapering form, so as to exert less pressure nearest where the laying or winding of the fillet or fillets takes place; and a gradually increasing pressure as the wound fillet advances further between them. 4th, The mode of operating the mandrel, and the pressure and guide rollers, whereby the fillets are first wound up on the mandrel to form the hose, and the hose is afterwards pushed longitudinally off the mandrel, viz; by giving rotary motion to the mandrel, while the carriage which contains or supports the rollers moves in one direction longitudinally in relation to the mandrel, and suspending the said rotary motion while the rollers move in the opposite direction. 5th, The combination of the clamps, flanched collars, pins or screws, springs, and elliptic collars, applied and operating in the head stock, to clamp the hose to the mandrel, and liberate it therefrom. 6th, The combination of the two spring clutches and the levers, the spring bolts, the tappets and the sliding bar, the whole operating together, to cause the roller carriage to be driven in opposite directions alternately."

73. For an *Improvement in Washing Machines;* Thomas A. Dugdale, Richmond, Ind.

Claim.—" Combining the vibrating frames and rollers, the plate, the knob, and pin, with the washboards and rollers."

74. For an *Improvement in Reefing Ships' Sails;* James Emerson, Worcester, Mass.

" My improvement relates to that class of reefing sails where the extra yard is used; the reefing being effected by chains or ropes leading down to the deck of the vessel, so that the sails can be reefed while the men are on deck."

Claim.—" The adjustable clamps when managed so as to be enlarged or decreased as required. Also, the screws and claws on the roller, for spreading the sail."

75. For an *Improvement in Revolving Fire Arms;* Josiah Ellis, Pittsburgh, Penna.

" My invention consists in the use and combination of a hammer, trigger, and spring pawl, so constructed and arranged, that the breech may be rotated, and the hammer raised to and retained in position at full cock, preparatory to firing, either by pulling the trigger, or by lifting the hammer by the hand, so that the pistol may be cocked by the hammer, or cocked by pulling the trigger, or fired without standing at full cock, at pleasure."

Claim.—" 1st, The use of a self-acting spring stop, operating directly by the trigger, in combination with suitable recesses in the revolving chambered breech, or their equivalents, for the purpose of locking the breech at the moment of firing, and leaving it free to rotate at other times. 2d, Making a cam for the bearing of the trigger spring, on the trigger back of the centre on which it springs, in order to admit of easy play and short motion of the spring, where a long sweep of the trigger is necessary. 3d, Constructing and arranging the trigger spring in such a manner as to serve the double purpose of a trigger spring and spring stop for locking the bolt. 4th, The combination and arrangement of the claw and notch on the hammer, the pawl or catch, and cam on the trigger, or other equivalent devices, for the purpose of retaining the hammer in its respective position when at full cock, and for effecting the rotation of the breech and cocking of the hammer preparatory to firing, either by lifting the hammer or pulling the trigger."

76. For an *Improvement in Machines for Forming the Brims of Felt Hats;* William A. Fenn, New Milford, Connecticut.

" My invention consists in the employment or use of a plain and a corrugated roller, vibratory clamp bar, and stretching segment, arranged and operating conjointly, whereby the lower portion of the hat body is drawn or stretched out horizontally, or at right angles with the crown, and properly formed, the hat body being placed or fitted over the block, which is rotated by the rollers as the brim is formed."

Claim.—" The employment or use of the rollers, vibrating bar, working over the bed and the serrated segment, with plate attached, arranged and operating conjointly. Also, in combination with the rollers, segment, and clamp, formed of the lever and bed, the adjustable frame which receives the block, the frame C being fitted within the frame B."

77. For an *Improved Hoisting Bucket for Coal, &c.;* George Focht, Reading, Pa.

Claim.—"1st, The knife-edged bar, arranged with a link and hook, whereby the handle is clasped with the front edge of the bucket. 2d, Pivoting the handle to the front of the bucket near the bottom, and clasping said handle to the front of the bucket, whereby said bucket is completely inverted, when said clasp is unlocked from said bucket, and whereby the tendency of any weight in the bucket is to keep said handle clasped with said bucket."

78. For an *Improvement in Gas Burners;* E. P. Gleason, Providence, R. I.

Claim.—"The peculiar arrangement of the holes, in combination with the connecting tube, and the perforations.

79. For an *Improvement in Treating Gutta Percha:* Robt. Haering. City of N. York.

Claim.—"In vulcanizing india rubber and similar gums, the use of pipe clay, or its equivalent, in combination with sulphur."

80. For an *Improved Expansive Bit;* Alexander Hall, City of New York.

Claim.—"In combination with a boring tool, an expanding bit or bits, whose turned cutting edge and shank passes through a mortise in the shank of said boring tool, and is secured therein by a pin, so that said expanding bit or bits may have a cutting edge from the centre of the boring tool to its extreme outer edge."

81. For an *Improvement in Apparatus for Feeding Fuel to Furnaces;* James Hemington, Richmond, Indiana.

Claim.—"Attaching the feeders to their shafts by joints, and applying springs thereto."

82. For an *Improvement in Coating Metals with Silver;* Levi L. Hill, Hudson, New York.

Claim.—"The combination of cyanide of silver, grape sugar, essence of sassafras, clay, and Paris white, or any of their equivalents respectively."

83. For an *Improved Method of Attaching Adjustable Buckets to the Shafts of Water Wheels;* J. R. Howell, Alexandria, Virginia.

Claim.—"The method of adjusting and securing the buckets to the arms of the water wheel, that is to say, the arrangement of the ribs, mortises, or their equivalents, and bolts, in combination with the flanched end of the arms of the wheel."

84. For an *Engraved Plate Printing Press;* M. C. Gritzner, Assignor to M. J. Gritzner, Washington, D. C.

Claim.—"Covering the wiping rollers or their equivalents, with oil cloth or oiled silk, or any material impervious to ink, for the purpose of having a wiping surface from which ink can be constantly removed by a scraper or otherwise, so as to keep it clean, in contradistinction to cloth, leather, or similar materials which absorb ink. Also, in combination with a reciprocating bed plate, carrying an engraved plate or its equivalent, to be printed from one, two, or more wiping rollers, revolving each upon its own axis, when the said axis has a reciprocating, rotating, or any other motion in a plane parallel with the plane of the bed plate. Also, passing a wiping band over two or more wiping rollers, when said rollers have the compound motion given to them. Also, producing the proper degree of pressure between the cleaning surface and plate, by means of a compressed gaseous or liquid fluid. Also, the manner of securing the plate to be printed from the bed plate."

85. For an *Improvement in Steam Boilers;* Nelson Johnson, Jasper, New York.

Claim.—"In combination with the employment of a direct internal flue, and a direct passage under the bottom of the boiler, both leading from the fire place to the chimney. Also, the arrangement of the two dampers, for the purpose of controlling the direction of the products of combustion, and using the boiler as a direct draft cylinder, boiler, or direct flue boiler."

86. For an *Improved Composition for Tanning Hides;* David H. Kennedy, New Alexandria, Pennsylvania.

Claim.—"The combination of valonia, the sulphate of soda, sulphate of magnesia, or sulphate of potash, and sulphate of alumina, sal soda, borax, or boracic acid, dissolved in water or tan bark liquor, for the purpose of tanning hides and skins."

87. For an *Improved Rammer for many-chambered Breech Fire Arms;* James Kerr, London, England.

Claim.—"Fitting the rammer for ramming the charges in the chambers of the rotating breech of fire arms, in a longitudinal groove in the side of the body or frame, in combination with the cam lever fitted to a mortise in the rammer for operating it."

88. For an *Improved Raking Attachment for Harvesters;* Daniel W. and Henry A. Lafetra, Eatontown, New Jersey.

Claim.—"Operating or giving a reciprocating motion to the rake, by means of the spirally grooved cylinder, in combination with the spirally grooved collar. Also, rotating the cylinder, by means of the self-adjusting wheel or roller, and vibrating shaft."

89. For an *Improvement to Prevent Incrustations in Steam Boilers;* Robt. M'Cafferty, Lancaster, Pennsylvania.

Claim.—"The application and use of gum catechu, to prevent and remove the incrustation in steam boilers and steam generators."

90. For an *Improvement in Wardrobe or Bureau Bedsteads;* James S. McCurdy, City of New York.

"The nature of my invention consists in so constructing a bedstead, that it can be used for sleeping upon. or as a toilet bureau."

Claim.—"The combination of the leaf and slatted sliding frame, and folding legs."

91. For an *Improvement in Molasses Cups;* Daniel W. Messer, Boston, Mass.

Claim.—"The adaptation of a movable surface or lip, (to vessels intended to contain molasses or fluids of the same viscidity,) said surface so situated in relation or position with the spout or channel way, and forming part of the same, that by moving the said surface, the viscid fluid or molasses which remains on the movable surface or lip, after pouring from the said vessels, is, by the practice of my invention, returned to a position where, by the force of gravity, it returns to the vessel, but in ordinary vessels, drips from the mouth or lip."

92. For an *Improvement in Sewing Machines;* Willford H. Nettleton and Charles Raymond, Bristol, Connecticut.

Claim.—"Forming the face of the press bar, next the material to be sewed, with diverging grooves, to keep the cloth stretched widthways, and prevent puckering under the operation of the needle. Also, the looper, formed with the notch into which the needle enters to ensure the taking of a loop, when said looper is combined with the slide and slot, or their equivalents, for giving the necessary sideways motion."

93. For an *Improved Machine for Drying and Pressing Paper;* John North, Middletown, Connecticut.

Claim.—"1st, The apparatus for cleaning the pressing cylinders 2d, In combination with the pressing cylinders, the drying apparatus, consisting of heated plates or chutes between which the sheets of printed paper are passed on tapes, without touching or dragging thereon."

94. For an *Improvement in Boot and Shoe Heels;* Stephen Oliver, Jr., Lynn, Mass.

Claim.—"My improved manufacture of heel as made by a mould, and in other respects, that is with a gutta percha body and tenon, a concave upper surface, and a bottoming of leather, or its equivalent."

95. For an *Improvement in Ice Breaking Boats;* Zachariah Oram, Camden, New Jersey.

Claim.—"The arrangement of a series of pointed plungers, operating vertically and in line with each other, whereby I have the advantage of the series for line or continuous splitting of the ice, instead of breaking in mass."

96. For an *Improvement in Self-Releasing Doors for Cotton Presses;* George W. Penniston, North Vernon, Indiana.

Claim.—"The traversing bar, in connexion with the arm of the plunger, for the purpose of retracting the key to release the doors when the plunger arrives at the proper point to make the bale being pressed the size required."

97. For an *Improvement in Flutes;* John Pfaff, Philadelphia, Pennsylvania.

"My invention consists in placing the mouth pieces of flutes at right angles, or thereabouts, to the stems or bodies, in order that greater convenience may be afforded to the players, and the distortion of arms, fingers, and neck, required in playing upon flutes of the ordinary construction, may be avoided."

Claim.—"The placing of the mouth pieces of flutes at right angles or thereabouts, to the stems or bodies of the same."

98. For an *Improvement in Watches;* George P. Reed, Waltham, Massachusetts.

Claim.—"Arranging and fastening the barrel, with respect to the pillar plate, (that is, so that it shall extend through the pillar plate, and be fastened to the dial side of it,) in combination with arranging the main gear wheel, so that it shall operate as a barrel head or cover to the barrel, and have the retaining power applied to it."

99. For an *Improvement in Lime-kilns;* William Robinson, Baltimore, Md.

Claim.—"In connexion with the central fire and partition, the arrangement of the side or auxiliary fires, for the purpose of more equally introducing the heat into the stack, and promoting more uniform burning."

100. For an *Improvement in Railroad Car Brakes;* Richard L. Smith, Philadelphia, Pennsylvania.

"My invention consists in the employ of sliding rods, situated below the axles, and extending the whole length of the car, the sliding rods connected to bars passing between rollers on the axles, and similar rollers on shafts, which have their bearing in hangers attached to the rubbers."

Claim.—"The sliding rods, with the bars having double inclined planes, in combination with the rollers, and the rollers when the latter are hung to the axles."

101. For an *Improved Lock and Clasp for Porte Monnaies;* Daniel C. Smith, Tecumseh, Michigan.

Claim.—"The combination of the several parts of the lock and clasp of a porte monnaie."

102. For an *Improvement in Curtain Fixtures;* C. H. Wheeler, Boston, Mass.

Claim.—"I do not claim broadly fastening the curtain to the rod by securing it to a wire that is introduced into a groove in the roll, having a narrow slit for the passage of the curtain, but this I only claim when the sides of the groove are straight and dovetailed, whereby the curtain is securely held to its roll, without other fastening."

103. For an *Improvement in Shirt Studs;* Dutee Wilcox, Providence, R. I.

Claim.—"My improved stud, as constructed with the arrangement and application of a slide bolt, with respect to the disk and the two arms turning on separate fulcra, and so as to operate therewith. Also, so constructing and arranging the disk of the slider, that its periphery shall extend or lap beyond that of the disk, in manner and so as not only to cover the said disk when closed down upon it, but also to enable a person to grasp the said disk between his thumb and finger, without at the same time grasping the disk. Also, forming the two levers with recesses in their heels, so that they may readily lap over and pass by one another without interfering, while being turned on their respective fulcra, and the heels brought close up to the locking slide, to enable it to lock them."

104. For an *Improved Machine for Splitting Wood;* William L. Williams, City of New York.

Claim.—"1st, The combination of the feeding chains with the stationary conveying floor, for effecting the feeding up of the sticks in a fire wood splitting machine. 2d, The movable side clamps operated by a positive motion, governed by the motion of the knives and proportioned to the displacement of the wood by said knives, for the purpose of supporting the sticks laterally, and also of relieving the pressure upon the same. 3d, The arrangement of the two separate knives, each extending entirely across the feeding floor, and being set at such angle to each other, and such distance apart, as will effect the cross or second cutting upon a block, which is not at that feed receiving the first cut."

105. For an *Improvement in Machines for Threshing Grain in the Field;* J. C. & F. G. Wilson, Cedar Hill, Texas.

Claim.—"The arrangement with a traveling thresher, of an endless gatherer and conveyor, armed with hooked teeth, in rows conforming to the surface passed over, to lift cut grain from the swath, and deliver it to the threshing mechanism."

106. For an *Improved Mode of Attaching Hubs to Axles;* Lorenzo Winslow, Rochester, New York.

Claim.—" The method of attaching the boxes of carriages to the axles thereof, by means of a ring and pin, operated in combination with the ring and pin or pins."

107. For an *Improvement in Apparatus for Boring Artesian Wells;* Jesse N. Bolles, Assignor to M. W. Bolles, Philadelphia, Pennsylvania.

Claim.—" The combination of cylindrical boring rods with cutters and valves, so constructed as to discharge the detritus upon the surface of the ground at every stroke of the drill, or any other mode substantially the same, which will produce the same effect."

108. For an *Improvement in Winding Machinery for Mines;* Edmund M. Ivens, Assignor to self and Lucien H. Allen, Tamaqua, Pennsylvania.

Claim.—" The arrangement of the traveling drums on concentric axes. Also, rotating the traveling drums by means of the rollers, and ribs, or guides, arranged at or near their inner periphery, or in any equivalent manner, whereby their hubs and axes are used merely as guides."

109. For an *Improvement in Baths for Photographic Purposes;* John H. Morrow, Assignor to self and Edwin Bennett, Baltimore, Maryland.

Claim.—" The improved form of constructing a compound or double chambered immersing bath, having an immersing chamber, and a dripping receptacle formed with slopes or inclined upper surfaces. Also, the suspension forked dipper device or tablet holder formed with the spur or ridge. Also, the brackets or rests, in combination with the immersing bath."

110. For an *Improvement in Boot Trees;* William W. Willmott, Assignor to self and Henry F. Gardner, Boston, Massachusetts.

Claim.—" Applying the rollers to curved transverse springs, so that such springs may cause the parts to give transversely, so as to correspond with the dimensions of the boot leg."

APRIL 21.

111. For an *Improvement in Closing Gas Retorts;* N. Aubin, Albany, New York.

Claim.—" The cover with the compound rim fitting it into the groove."

112. For an *Improvement in Steam Traps for Relieving Steam Pipes of Water;* John Avery, Jr., Lowell, Massachusetts.

"My invention relates to a contrivance to be attached to any steam pipe or way, so that it will allow the water of condensation to discharge itself, but at the same time prevent an escape of the steam."

Claim.—" In combination with the outer case, the enclosed mercury holder, and diaphragm, and openings."

113. For an *Improved Door Spring;* Gilbert L. Bailey, Portland, Maine.

" The nature of my invention consists in providing a volute cuniform spring, which is pressed upon by a lever when the door is opened, and its tendency to resume its original shape closes the door, by forcing the outer end of the lever—which has a roller attached—to the outer end of a guide fastened to the casing, and so formed as to cause the greatest pressure on the door when it is nearly shut."

Claim.—" The use of the volute cuniform spring, in combination with post, lever, and guide."

114. For an *Improvement in Ox Yokes;* Isaac K. Bennett, Narrows, Pennsylvania.

Claim.—"The pinions on the pivots of the bow blocks, in combination with the racks into which they gear."

115. For an *Improved Knife for Cutting Veneers;* Gilbert Bishop, City of N. York.

Claim.—"Constructing the knife in sections, each having alternate smooth and toothed cutting edges attached together."

116. For an *Improved Method of Excluding Air from Liquors on Tap;* Absalom F. Boyd, Muskingum Co., Ohio.

Claim.—"The application of the bag to a cask or barrel, for the purpose of preserving the flavor of liquors, by excluding the atmosphere from them when the cask is on 'tap.'"

117. For an *Improved Waste-way in Faucets;* James E. Boyle, Richmond, Va.

"My improvement relates to stop-cocks intended to establish a cut-off at pleasure, the communication between two branches of pipe, and with the reservoir they are connected with, in such a manner that the waste liquid shall not remain in the pipe, where it may cause injury by freezing or other causes."

Claim.—"The recess and orifice, in combination with the channels, when constructed and arranged in relation to the ordinary component parts of stop-cocks."

118. For an *Improved Method of Clamping and Unclamping Panels of Portable Field Fences;* Wm. B. Burnett, Lyons, New York.

Claim—"The turn button clamp, or its equivalent, for connecting the trays of a portable fence."

119. For an *Improvement in Cask Heaters;* Simeon Burgess, Wayne, Penna.

Claim.—"Combining with the fire-pot, the encompassing hearth, with the adjustable pins for securing casks of different sizes in a concentric position."

120. For an *Improvement in Chimney Dampers;* Augustine Campbell, Philadelphia, Pennsylvania.

Claim.—"The angular frame, provided with a series of valves or vanes."

121. For an *Improved Awl Haft;* Nathan S. Clement, Worcester, Massachusetts.

Claim.—"An awl haft having the chamber for spare awls on the same end with the griping jaws."

122. For an *Improvement in Gas Regulators;* Robert Cornelius, Philadelphia, Pa.

"The nature of my improvement consists in the employment of a metallic spring box, in combination with a valve of peculiar construction, for the purpose of so regulating the flow of gas through the burners, that the escape of gas from any given pipe to a number of burners shall be under a uniform, or very nearly uniform pressure, no matter how many burners attached to such pipe are opened."

Claim.—"1st, The employment of a spring box or boxes, composed of two plates of corrugated metal, and placed intermediately, so as to communicate on the one hand with the gas in the main chamber, and on the other with the branch chamber, being separated by the throttled openings. 2d, The employment of the valve, in combination with the spring box, for regulating the flow of gas."

123. For an *Improvement in Hand Seed Planters;* Thomas Crane, Fort Atkinson, Wisconsin.

Claim.—"The combination of the pivoted and spring actuated block, with the grooved and perforated sliding slat. Also, the combination of the spring with the grooved and perforated sliding slat, in such a manner that the inclined aperture in the back of the planter will operate said spring."

124. For an *Improvement in Hand Seed Planters;* John Decker, Sparta, New Jersey.

Claim.—"The sides fitted in the box, placed relatively with the hoppers, and the plates or clearer attached to the block, when the above parts are combined and arranged so as to operate conjointly."

125. For an *Improvement in Bustles;* Alexander Douglas, City of New York; antedated January 26, 1857.

Claim.—"The combination of the elastic strips, the steadying cloth, (or its equivalent,) provided with strips or fastenings, and the adjusting cord."

126. For an *Improvement in Machines for Blocking Hat Bodies;* Wm. A. Fenn, New Milford, Connecticut.

Claim.—"The cylinder, placed loosely on the spindle or arbor resting on the spring, in combination with the rods or jaws, whereby the hat body may be stretched and adjusted snugly around the hat block."

127. For an *Improvement in Machines for Making Rope;* Harvey W. Fowler, Hoosick Falls, New York.

Claim.—"1st, The stationary disk, arranged in relation to the layer shaft, and the spider, for the purpose of communicating motion to the flyers through the flyer pulleys. 2d, Arranging the series of flyer shafts radially to the layer shaft, and revolving them when the layer shaft is revolved, so as to give the proper degree of twist to the threads or strands, as they leave the spools or bobbins in the flyers, by the peripheries of the flyer pulleys being kept in contact with the face of the stationary disk, the said pulleys being adjustable nearer to, or further from, the centre of the layer shaft, to decrease or increase the speed of the flyers, and through that, to give a less or greater degree of twist to the thread or strand."

128. For an *Improvement in Messenger Shackle Blocks;* George Gilmour, Chelsea, Massachusetts.

"The object of my invention is to enable a purchase block to be connected with a chain cable, when such may be attached to an anchor or vessel, or other article, and particularly when said chain cable may be under water."

Claim.—"The messenger shackle block, or combination and arrangement of the sheaves or pulleys, the forked pawl, the roller, and the chain space or passage. Also, hanging or jointing the parts and the pawl to the remainder of the frame, in order that the roller and pawl may be turned towards the sheaves of the pulley. Also, combining the pawl and the pulley frame, a mechanism by which, by pressure of the chain against the pawl, such pawl may be caused to lift the parts, and the roller to facilitate the movement of the shackle block on the chain."

129. For an *Improvement in Burners of Burning Fluid Lamps;* Charles A. Greene, Philadelphia, Pennsylvania.

Claim.—"The hollow burner with its rounded or semi-spherical cap, and its projection, when the whole is rendered adjustable to the main table tube."

130. For an *Improvement in Tea Kettles, &c.;* James Greenhalgh, Senr., Waterford, Massachusetts.

"My invention consists in connecting the cover of the kettle with the handle or bail, whereby the cover, when adjusted over the top of the kettle, will keep the handle or bail elevated, and when the handle or bail is moved to one side, the cover will be raised."

Claim.—"Connecting the cover with the bail or handle, by means of the bar passing through a slot in the bail or handle."

131. For an *Improvement in Automatic Rakes for Harvesting Machines;* Jonathan F. Green and Israel Dodenhoff, Bloomington, Illinois.

Claim.—"The mode of attaching rakes to endless belts or chains, and of properly guiding the same, whereby the lateral and vertical deflexion of the band is prevented in operating the rakes; that is to say, hinging the rakes to the belt by means of jaws and projecting lips, when combined with guide pins working in grooves to prevent lateral deflexion, while a guide bar keeps the rake down to the platform in raking off the grain.',

132. For an *Improvement in Hand Seed Planters;* Plymon B. Green, Chicago, Ill.

Claim.—"The combination of slide, catch, and stop, constructed and arranged to hold the plunger stationary until the point enters the earth to a certain depth."

133. For an *Improvement in Portable Apparatus for Generating Illuminating Gas;* James O. Halsey, Essex Co., New Jersey.

Claim.—"The air chamber, to allow both the retort to be charged while the fire is in operation, and to carry off the gas that escapes from the said retort, and prevent its entering the room."

134. For an *Improved Cotton Cultivator;* John M. Hall, Warrenton, Georgia.

"The nature of my invention consists in making my hoes in such a manner, and so attaching them to the wheel, that they shall enter the ground at regular spaces, having a regular space between each cut, and at any required depth."

Claim.—"In combination with the wheel, the adjustable hoes."

135. For an *Improvement in Hemp Brakes;* Wade W. Hampton, Winchester, Va.

"The nature of this invention relates to that class of hemp brakes in which the material is fed, broken, and discharged in hanks."

Claim.—"The clamping, and feeding the clamped material through, between the breakers."

136. For an *Improved Hydrant;* Abraham Hoagland, Jersey City, New Jersey.

"The nature of my invention consists in emptying the pipe of the water (by drawing it out), to a depth below frost, and keeping it closed to prevent the circulation of air."

Claim.—"1st. The emptying the pipe by a self-actiug valved piston with hollow rod. 2d, The construction and use of the valve made of an ordinary bevel winged valve, with the flexible valve added at the bottom, and the cushion added at the top. 3d, The combination of the catch upon the large friction pulley, with the collar, to enable the operator to force down by the crank the piston upon the valve, and open it against pressure."

137. For an *Improvement in Carding Machines;* Hiram Houghton, Somers, Conn.

"The nature of my improvement consists in the arrangement of a third roll, with the seed rolls and licker-in, for the purpose of preventing the fillet of the feed rolls from filling up."

Claim.—"The combination of the third roll with the feed rolls and licker-in."

138. For an *Improved Means for Inhaling Medicinal Agents;* Alonzo G. Hull, City of New York.

Claim.—"The means of inhaling gases, vapors, and medicines."

139. For an *Improvement in Vault Covers;* George R. Jackson, Rye, New York.

Claim.—"Combining glasses of an inverted pyramidal or polygonal form, with the sash or metallic portion of an illuminating vault cover, for the purpose of producing a wider and more perfect diffusion of the light which may pass through said cover into the apartment beneath."

140. For an *Improved Method of Ventilating Vaults;* George R. Jackson, Rye, N. Y.

Claim.—"Connecting the elevated recesses in the ceilings of subterranean apartments, with ventilating lamp posts, or with the flues of a building."

141. For an *Improved Lime-kiln;* Aaron Jeffries, Alleghany County, Penna.

"The nature of my invention consists in the peculiar arrangement of three arched furnaces and three cooling flues, within a hexagonal stack of a lime-kiln."

Claim.—"The combination and arrangement of the three furnaces, with the cooling or draft flues, when the same are constructed and arranged in relation to each other, within a hexagonal stack."

142. For an *Improved Saw-Set;* Oliver P. Judd, Little Falls, New York.

Claim.—"The gauge having the jaws when used in connexion with the revolving plate."

143. For an *Improvement in Reefing Sails;* Francis C. La Croix and Chauncy Barnes, City of New York.

"Our invention consists in a peculiar method of reducing the top-sails from the deck, whereby, if reduced to a storm-sail, the operation of reefing may be dispensed with, or if less reduced, the reefing is rendered much less laborious than by the ordinary methods."

Claim.—"Reducing sails by means of 'tackles,' both ends of the 'falls' of which are secured to the yard."

144. For an *Improvement in Bathing Apparatus;* Louis H. Lefebvre, New Orleans, Louisiana.

Claim.—"1st, Providing a portable frame and casing, used to be placed over persons to administer baths without removing them from their positions, and attaching to said portable frame a graduating stop-cock, provided with a reservoir to receive the condensed vapors, with the handle of said cock extending into the frame, and beneath the casing, to enable the person taking the bath to operate the graduating cock. 2d, Perforating the pipe or reservoir from which the vapors issue into the bath on its upper side, and placing beneath it a pipe or reservoir to receive the condensation, uniting said pipes or reservoirs by funnel-shaped connexions, through which the condensed vapors may escape. 3d, The distributing pipe provided with double funnels and stop-cocks, for the introduction of medicated, or other substances, into the bath through the connecting pipe."

145. For an *Improvement in Instruments for Curling Hair;* Mark M. Lewis, Albany, New York.

Claim.—"The construction of a hair curling instrument, by the combination of a taper-formed tube, with a comb which can, by a spring or equivalent apparatus, be made to project from the surface of the tube, or withdrawn into the interior."

146. For an *Improved Shingle Machine;* G. H. Mallary, City of New York.

"My improvements are for the purpose of simplifying the working parts of the apparatus, and causing more accuracy and durability therein; and in so arranging and combining a saw and cutter, as to properly operate upon the shingle at the same time, the cutter or plane being made to vibrate so as to plane the shingle while sawing to the usual taper."

Claim.—"The arrangement of the several devices, by which the bolt is sawed into shingles and planed."

147. For an *Improvement in Smoothing Irons;* Galen B. McClain, Bath, Maine.

"My invention consists in the peculiar construction of the iron, whereby it may be quickly heated, and the heat retained for a considerable length of time."

Claim.—"The sad iron, with its doors or flaps."

148. For an *Improvement in Cooking Stoves;* Thomas King, West Farms, N. Y.

Claim.—"The arrangement and combination of the box, register, or pot hole, and flues."

149. For an *Improvement in Combined Square, Mitre Square, and Bevel;* Alexander McKenzie, Boston, Massachusetts.

Claim.—"The arrangement of the try square, the mitre, and the bevel blade, the latter being hung so as to project upon the opposite side of the stock from the blade, and so as to form when set at an angle of 45° a continuation of the mitre head."

150. For an *Improvement in Dental Forceps;* J. A. McClelland, Louisville, Ky.

Claim.—"Connecting the handles to the head pieces of the instrument, by means of suitable joints and appendages, arranged in such a manner that the shape of the instrument can be so changed as to adapt it to the drawing of upper or lower teeth. Also, combining the beaks with a dental forcep, in such a manner that their length can be increased to any desirable extent."

151. For an *Improvement in Method of Securing the Doors of Hay Presses, &c.;* Cornelius Martratt, New Baltimore, New York.

Claim.—"The form of the crank or loop, the elliptic or eccentric form of the ends of the battens, and the combination of the one with the other, for the purpose of securing a door or hatch, and for the purpose of preventing a sudden and dangerous start of the door in opening, by means of the gradual movement of the battens outward, as the loop is turned off from them."

152. For an *Improvement in Moulds for Casting;* Mortimer Nelson, City of N. Y.

Claim.—"The method of forming moulds for casting britannia and other metals, by backing up a thin metallic face with plaster."

153. For an *Improvement in Grinding Saws;* Albert L. Nippes, Lower Merion, Pa.

"My invention consists in the employment or use of a bearing roller, fitted within a swinging and pivoted or adjustable frame, whereby the roller may be raised and placed out of the way of the saw to allow the same to be turned in its frame or sash, and the roller also allowed to be placed angularly, so that the saws may be ground transversely in taper form."

Claim.—"1st, Placing the roller within a frame which is pivoted to a bar which has its journals substantially fitted in oblong slots or bearings, so that said roller may be elevated or raised up, free from the saw, and also be adjusted more or less angularly, with the face of the grindstone. 2d, Operating or moving the stone and roller towards and from the saw, by connecting the bearings of the shaft of the stone and the journals of the bar to the disk and ratchet, by means of the arms and the rods."

154. For an *Improvement in Machines for Forming Clay Pipes;* Charles P. S. Wardwell, Lake Village, New Hampshire.

Claim.—"The arrangement and combination of the respective devices, by which the necessary and successive stoppings and startings of the piston are effected, by which the dies are opened and again closed at the proper moments, and by which the knives are brought into action when required, all by simply moving the lever up and back again in connexion with the pressure of the clay against the piston."

155. For an *Improved Method of Adjusting and Holding the Knives of Spoke Shaves;* Manly Packard, North Bridgewater, Massachusetts.

Claim.—"The new arrangement of the clamp screw and bow spring, with respect to the handle and starts of the knife or cutter, and so as to operate therewith."

156. For an *Improved Sawing Machine;* H. F. Purmont, Saginaw City, Michigan.

Claim.—"The sliding heads placed on the blocks, and operated by the pinions, racks, pawl, and ratchet, and the carriage operated by the wheels placed on the shaft."

157. For an *Improvement in Washing Machines;* Joseph F. Pond, Cleveland, Ohio, and Charles L. Pond, Buffalo, New York.

Claim.—"The combination of the vibrating stop piece and its rod, with the screwing plate and the spring bearings of the rollers, when said parts are used in connexion with fluted rollers."

158. For an *Improved Mode of Dumping Railroad Cars;* Wm. Pearce and John Lowrie, Piedmont, Virginia.

Claim.—"1st, The method of discharging cargo from cars by means of a rocking track. 2d, The mine car, constructed without any openings in its sides, ends, or bottom, for discharging its cargo, and with its ends raised higher than its sides. 3d, The ribs or flanches, in combination with the rocking track. 4th, The shoes, in combination with the projections for steadying the rocking track whilst the cars are run on and off. 5th, The method of breaking the rocking car (as it is capsized to discharge the coal, and afterwards raised), by means of the brake and wheel, the latter being mounted on the shaft of a pinion operated by means of a rack and pitman, or their equivalents. 6th, The arrangement of the cam stud, in combination with the latch bar, by which the doors of the rocking car are released when it is brought into proper position to discharge its cargo into the chute."

159. For an *Improvement in Machines for Felting Hat Bodies;* Henry L. Randall, Roxbury, Connecticut.

Claim.—"1st, The rising and falling, and forward and back motions of the felting board, by a system of levers, or their equivalents. 2d, Rotating the bat or roll of material being felted round its own axis. 3d, In combination with the felting board, when operated, the adjustable stationary stocks or carriages for holding the roll or bat."

160. For an *Improvement in Grinding Mills;* Ezra Ripley, Troy, New York.

"My improvement relates to those mills in which the grinding is performed wholly or in part, by or between plates or flat grinding surfaces, one of the grinding plates being constantly revolved."

Claim.—"Giving the grinding plate, when it is applied to a constantly revolving grinding plate, the positive two-fold eccentric and swinging movement, in contradistinction from giving to the grinding plate, when used with a rotary grinder, a simple eccentric, swinging or reciprocating motion, or any other simple or compound movement heretofore positively communicated thereto in grinding mills."

161. For an *Improvement in Harness Saddles;* Palmer Shaw, Syracuse, New York.

"The nature of my invention consists in a method of constructing harness saddles by making the cantle of a single piece of leather, shaped so as to give the desired form to the cantle, and connected by stitching at its upper edge to a raised portion of a piece of leather from which the skirts are formed, and completing the tree by attaching the parts thus made to a bearing plate shaped in the form suited to the horse's back."

Claim.—"Making the tree of harness saddles to consist essentially of the leather cantle piece, connected to the raised portion of the piece of leather from which the skirts are formed, and the whole attached to the bearing plate."

162. For an *Improved Lubricator;* Hiram Strait, Covington, Kentucky.

Claim.—"The oil cup with its sliding bottom, thumb-screw, guides, in combination with porous oil bags or pieces of sponge, or any other porous and elastic material saturated with oil, and the spring."

163. For an *Improved Current Water-Wheel;* Thomas Stamp, Wetumpka, Ala.

Claim.—"So constructing a current water-wheel, that it may be raised and lowered in combination with the method described for regulating the force of current acting thereon, all arranged and combined."

164. For an *Improvement in Machinery for Winding Conical Bobbins;* Clark Tompkins, Troy, New York, and John Johnson, Roxbury, Massachusetts.

Claim.—"1st, The manner herein described, in which the speed of the winding bobbins is charged, so as to constantly draw the yarn from the fixed bobbins with uniform or nearly uniform swiftness, and thus secure more even tension on the winding yarn, and thereby make the new bobbins of more uniform density than if they were revolved with uniform velocity. Also, in machines for simultaneously winding a series of such bobbins, giving each bobbin spindle of the series the proper independent retreating movement from the yarn carriers as the winding progresses, by means of the mechanism, or its equivalent, in contradistinction from giving each bobbin the separate retreating movement, by means of a fixed guide, acting against the conical part of the wound yarn, and instead of making all the bobbins more endwise. Also, when the revolving bobbins in such machines are separately moved endwise by the mechanism shown in the drawings, connecting each thread of yarn as it runs to a bobbin of the series, with the parts which give that bobbin its retreating movement, by means of a device arranged and operated upon by the tension of the winding yarn, so that whenever a thread of yarn in such case breaks or runs out, the bobbin upon which it was winding at once stops moving endwise, and consequently so that when the yarn is mended, and the winding resumed, the yarn is then laid by the carriers in exactly the proper place on the bobbin, without any re-adjustment of the bobbin by the operative. And, finally, the combination of parts, whereby the rotary motion of each bobbin is stopped whenever it is slid by the mechanism to that place, in respect to the yarn carriers, where the winding should end."

165. For an *Improvement in Harrows;* George W. Tolhurst, Cleveland, Ohio.

"The nature of my invention relates to a harrow which can be rotated to the right or left by simply dragging it across the ground, as the operator may desire, or the slope of the ground require."

Claim.—"The adjustable shield pieces, in combination with the rotary harrow."

166. For an *Improvement in Swage or Cable Springs;* Wm. Wilcox, East Hartford, Connecticut.

Claim.—"The arrangement of the springs, and the springs within the cylinder."

167. For an *Improvement in Harvesters;* J. C. and T. G. Wilson, Cedar Hill, Texas.

Claim.—"Operating the reel by means of the rigid pin and spring arm attached to pulley, in combination with ratchet, arms, and holding spring, when said parts are arranged to operate in relation to each other."

168. For an *Improvement in Oil Cans;* Hiram Wells, Florence, Massachusetts.

Claim.—"The conical cup and ball, so arranged as to close the valve when the can is turned down to deliver the oil contained in it."

169. For an *Improvement in Mode of Attaching Bolting Cloths to Reels;* John Woodville, Chillicothe, Ohio.

Claim.—"Forming the cloth in sections, and securing the sections to the reel by means of the rods and bars which are attached to the bars—bolts and bars which are attached to the rim by screws. Further, the bolts, provided with the oblong and T shaped heads, and washers."

170. For an *Improvement in Blacksmiths' Butteris;* Robert Killmer and Joshua W. Williams, Assignor to Robert Killmer, Newtown, Pennsylvania.

Claim.—"The construction of the butterises with removable two edged bits or blades secured to a plate having rectangular sides, by half flanches only."

171. For an *Improvement in Potato Diggers;* John Taggart, Roxbury, Assignor to self and Wm. W. Messer, Boston, Mass.

Claim.—"The combination and arrangement of the plough, the grid or grate, the revolving tooth lifter wheel or wheels, and the means of discharging the potatoes from the same."

172. For an *Improved Stave Machine;* Henry L. McNish, Assignor to self and David C. Butler, Lowell, Massachusetts.

Claim.—"The angular guides upon the lever, in combination with the connexions and concomitant parts for adjusting the side cutters, to dress staves of different widths, and, at the same time, preserving the proportion between the bilge and the width of the stave. Also, the guide on the bed plate, for the purpose of guiding the staves in a direct line through the machine."

173. For an *Improvement in Brick Machines;* G. I. Washburn and E. H. Bellows, Assignors to selves and C. Washburn, Worcester, Mass.

"Our invention consists in certain improvements on a brick machine, for which letters patent were granted to us on the 7th day of October, 1856, and has for its object to apply the pressure to the brick in the mould, both on top and bottom, and also consists in an improved mode of applying the pressure to a plunger."

Claim.—"1st, The method of applying pressure to the plunger, by means of the radial arms and levers. 2d, The combination of the radial arms with the sliding moulds and moving block, or plunger."

174. For an *Improvement in Argand Gas Burners;* Charles H. Johnson, Assignor to self and Joseph G. Hamblin, Boston, Mass.

Claim.—"The improvement of constructing the supporting tube of the brackets, so that it may not only sustain such brackets, or have them extended from it, but at the same time admit the register to be operated, by simply laying hold of and turning either the globe or chimney, when the friction thereof on the brackets may be sufficient for the purpose."

175. For an *Improved Fluid Metre;* Samuel J. Burr, Assignor to self and Henry F. Read, Brooklyn, New York.

Claim.—"1st, The combination of the flexible partition with shifter, for the purpose of opening and closing the valves or apertures to admit and discharge the fluid, so that the apartments shall be alternately filled and emptied. 2d, The combination of the valves, tube, and flexible partition, so as to make the entering fluid discharge the fluid (alternately) in each apartment, by its pressure upon the opposite side of the flexible partition. 3d, The shifter, as set forth, or in any other form producing the same result, and placed between the two portions of the flexible partition and the packing of the tube, by the outer edges of the two portions of the flexible partition, protecting shaft, and shifter, from contact with the packing, and allowing the said shaft to work freely at the same time. 4th, The combination of the shaft enclosed in the tube with the valve throw."

MECHANICS, PHYSICS, AND CHEMISTRY.

On an Improved Water Metre.[*]

In January, 1854, the writer communicated to this Institution a paper on an improved water metre, in which he described several mechanical arrangements whereby water flowing through pipes might be measured with sufficient accuracy for practical purposes, without destroying the pressure or head of water column. In the course of considerable

[*] From Newton's Lond. Journal, January, 1857.

experience with the these metres, several important improvements suggested themselves, and opportunities occurred of observing the public importance of supplying water by metres.

The chief difficulty that presented itself in endeavoring to produce a practically perfect high-pressure metre, was not so much to obtain a correct measurement under varying circumstances of pressure, as to render the instrument sufficiently durable to resist for years the action of the water and of the impurities carried along with it. It was found necessary to protect all the working parts against the chemical action of the water, to prevent deposit of calcareous matter upon the measuring apparatus, and to combine strength with lightness as far as possible in the construction of the movable parts, in order that they might resist the force of a high water column, and might yet be moved by the slender stream produced by a leaky tap, which in the case of the smaller metres may not exceed half-a-pint of water passing through per minute. Cheapness and compactness of construction were other important considerations not to be lost sight of.

The water, before entering the metre, has to pass through a grating which arrests any solid matter, and is made easily accessible for the purpose of removing, from time to time, the impurities that have collected, when it is found that the passage of the water is obstructed.

It is important to make the area of the inlet nearly equal to the collective area of the outlets of the drum, but a little smaller than the latter. The area of the inlet should accordingly be, for smaller metres, ten per cent., and for the larger, five per cent. less than that of the outlets, to allow for loss of velocity by friction in the drum. This loss may be taken to represent, with tolerable accuracy, the degree of obstruction opposed by the metre to the moving water column. The rapid current of the water through the inlet and the curvilinear channels of the drum has been found to prevent deposit of calcareous matter in these places, which is an important point; for were it otherwise, the metre would gain in relative speed in proportion as the area of the channels was diminished.

Metres constructed on this plan have been found to work continuously for nearly three years under the most varied circumstances, without requiring any alteration whatever. The arrangement made between the manufacturers and the water companies or purchasers of the metres is, that every metre that fails to give satisfaction, in consequence of stoppage or inaccuracy of measurement, shall be exchanged; and experience shows, that the number of metres so returned does not exceed 2¼ per cent. in the year; and these for the most part have been sent back only from trivial causes. The more serious accidents have been, that the metre has become choked with gravel or other impurities that had entered through a broken grating; or that the regulating vanes have been broken, and the relative velocity of the revolving drum has been much increased; or that some derangement in the wheel-work of the counting apparatus has taken place. In winter it has happened that the casing of the metre has been burst by frost; but this class of accidents does not concern the mechanical arrangements of the metre. The manufacturers enter into contracts to maintain the metres supplied by them in good working condition for a term of years, in consideration of the moderate annual charge of five per cent. per annum on the first cost; proving thereby their own confidence in the durability of the metres.

A further object of this paper is to prove, from actual experience, the utility of the metre to water companies and water consumers, and to engineers and others, for general purposes.

Although the metre has been as yet but partially applied by water companies, as the arbiter between themselves and their irregular or trade customers, the advantages to the companies from the prevention of waste, error, and fraud, have been made manifest. The following table gives the results of the application of fifteen metres, showing the difference between the rate paid previous to their application, and the established value of the water actually supplied according to the metres:—

Number of Reference.	Rate Paid.	Value of Water Consumed.
1	£40	£1050
2	40	400
3	50	450
4	40	78
5	35	64
6	18	500
7	365	500
8	15	45
9	£7	£21
10	7	21
11	7	21
12	20	95
13	12	110
14	13	115
15	16	700

TOTAL ... ... Rate Paid, £685. Value of Water Consumed, £4170.

It appears from this table that the collective rates paid by fifteen consumers amounted to £685; whereas, according to the established value of the water, they ought to have paid £4170, or more than six times the amount. These are no doubt exceptional cases, which have come particularly under the notice of the manufacturers, because the correctness of the metres was disputed by the consumers; but they show the utter impossibility of estimating the quantity of water supplied by a given pipe without the application of a metre. In several of the cases stated in the table, the consumers themselves applied for the metre, because they thought the rate they paid was excessive. They calculated, no doubt, correctly, the water actually required for their manufacturing operations; but did not take into account the lavish waste that is continually going on by taps leaking or left open, by broken pipes, and by inundating instead of washing floors and utensils, &c. From all the information the writer has been able to collect, he ventures to affirm, that fully one-half of all the water supplied by the permanent supply system, which is at present made compulsory by Act of Parliament, is absolutely wasted, without utility either to the consumers or to the water companies. It cannot even be said that the water thus wasted is useful in a sanatory point of view, by cleansing the sewers, because the deposit contained in the sewers can be removed only by flushing them from time to time.

The value of the water that is so wasted may be estimated from the fact that one water company alone, the East London, sells at present nearly 800 millions of gallons a year by metre, which, at the price of 6d, per 1000 gallons, amounts to a rental of £20,000 per annum. They employ for this purpose only about 200 metres, which are, however, of more than the average dimensions.

In order to detect and prevent all waste of water, it would be necessary to apply a metre not only to the branch pipe of every irregular consumer, but also to every branch main supplying a district or a street. The legitimate consumption of each district or street, would then be soon ascertained, and if in any one week it exceeded that amount, the metre would at once draw attention to the fact; the cause of which would frequently be found to be a leakage from the branch main underground into the sewers, which it is at present impossible to detect.

In order to render the system of supply by metre perfect, it should be extended also to private houses. Objection has been raised against this proposition, on the ground that the poorer housekeepers would economize water with detriment to their own sanatory condition, and also that the cost of the metre is too high in proportion to the amount of rent they pay. These objections are applicable, however, only to the case of laborers' cottages, which indeed might be supplied without restriction, or might be charged a fixed rate, till their consumption exceeded a certain maximum. It should, however, be borne in mind, that the principal value of metres to water companies consists in prevention of waste; and it is a question open for discussion, whether the waste going on in houses on the permanent supply system, does not far exceed the cost of maintenance and investment of a metre, which, indeed, would not be more than the cost of the present cistern and ball taps.

A system of supply by metres, would relieve the officers of the water companies from much watchful care and unpleasant discussion with the customers about the quantity of water they consume. The advantages derived by consumers from being supplied by metres, are,—first, that each consumer pays only for the water actually used by him, whereas, at present he must pay also his share of all the waste that is going on;—secondly, the metre is useful to the customer for regulating the distribution of water on his own premises, and for preventing waste by his own servants;—and thirdly, the general prevention of waste will enable water companies to reduce their charges.

There are many other useful applications of an efficient, cheap, and compact water metre, one of the most important of which, is the application to steam boilers. By inserting a metre into the suction pipe of the feed pump, a correct indication is obtained of the water actually evaporated, which serves as a check on the one hand upon the performance of the engine, and on the other hand upon the quality of the fuel employed, or the care of the fireman in burning it.

There are at present upwards of 2000 of these metres in constant use at several large towns in this country, including London, Bristol, Edinburgh, Newcastle, Yarmouth, and Leeds; and also upon the continent, at Berlin, Amsterdam, and elsewhere.

The sizes of the metres vary from ½-inch to 12 inches diameter of supply pipe; and excepting the comparatively few cases of defective metres above alluded to, which, according to a careful register kept by the manufacturers, have amounted to not more than 33 cases in a year out of about 1500, the results have been highly satisfactory as regards both the correctness of measurement and the durability of the metre.

Mr. Siemens exhibited several metres of different sizes, and specimens of the revolving drums, from the smallest size, with a drum 1½ inches diameter, intended for a pipe ½-inch diameter, delivering 5 gallons per minute, up to one of the largest size, with a drum 8 inches diameter, intended for a main 10 inches diameter, delivering 500 gallons per minute. A ½-inch metre was also exhibited, and shown in operation at the meeting at various rates of discharge, having a glass casing, allowing the motion of the rotating drum to be seen while in action.

The Chairman observed, that there had been hitherto much difficulty in obtaining a correctly registering metre; and now that water was so much more generally introduced by water companies, into houses, &c., it was important to have an accurate and durable metre, that could be fully relied upon.

Mr. Allen inquired whether the drum would make many revolutions by its momentum, after a sudden stoppage of the discharge; he thought that it would be liable to do so, especially under a high pressure or a great velocity, and that the metre would then register too large a quantity.

Mr. Siemens replied, that the tendency of the drum to overrun, when the discharge was stopped, was now successfully prevented by the retarding vanes fixed upon it, by the resistance of which, in the stationary water, it was speedily brought to rest. It had been ascertained by experiment, that when the drum was rotating at 2000 revolutions per minute, only 5 or 6 revolutions were made by it after the discharge had been suddenly stopped; and the little error arising from this cause was nearly compensated for, by the effect produced by the inertia of the drum at the commencement of motion—a small quantity of water having to pass through the drum not registered, before the drum had attained the velocity, corresponding with the velocity of the water through the metre. As an extreme test, he might mention an instance in which a metre had been used to measure the water supplied to an engine boiler, and had been placed between the feed pump and the boiler, and consequently, the drum was set in motion and stopped at each stroke of the pump, and went with jerks; but even under this severe trial, the metre was found to register only about 5 per cent. in excess. In such a case it would be necessary to provide an air vessel to equalize the flow through the metre; but even without such addition, the amount of loss at each stoppage was evidently very small.

Mr. Greaves, of the East London Water-Works, was particularly glad to be able to bestow praise on the present invention, having so often been unable to form a favorable opinion of water metres. He had paid considerable attention to the several metres that had been brought forward, and the first that occurred to him as having been practically useful, was that by Sterling, whose metre was formed of a horizontal revolving drum; this was, however, found faulty, and could not be used under high pressures. The original screw metre, invented by Mr. Siemens, had proved defective. Piston metres, consisting of a piston driven up and down in a cylinder by the water, which was admitted alternately at the top and bottom of the cylinder, had been frequently attempted, but unsuccessfully. Trials had also been made of double-chambered metres with door pistons, which might be said to consist of a pair of coupled engines worked backwards ; but elastic diaphragms, as used for gas, were not suitable for water. In Siemens' new metre, now under consideration, the measurement of the water depended on the principal of reaction ; the drum being caused to rotate by the reaction of the water in passing through it. After having experimented carefully on all the above metres, he had found that of Mr. Siemens to be the best, and it had proved very satisfactory in working. Of the other metres, he preferred that by Kennedy, of Kilmarnock.

The great difficulty to be encountered had been to produce a metre that would answer equally well under all varieties of pressure and velocity, and would transmit the full pressure of the water. He believed the previous metres had failed of accomplishing this fully, but it appeared to be attained in the present instance. Mr. Siemens' metre, the addition of the retarding vanes on the drum, was an important point, as the increasing resistance they encountered from the water checked the drum, and counteracted the tendency that it had to rotate at an increasing speed, which would otherwise produce an error in the registration. At the East London Water-Works, a large number of these metres of various sizes, were being used at the present time ; of which 16 were ½ inch, 18—¾ inch; 31—1 inch; 16—1¼ inch; 17—1½ inch; 43—2 inch; 17—3 inch ; 7—4 inch ; and 2—6 inch. The total quantity of water supplied through these metres, was 2,000,000 gallons per day, at a minimum value of 6d. per 1000 gallons, and a correct measurement was, therefore, a matter of great importance ; this being, he believed, a larger quantity of water than was measured through metres by any other parties, although he understood that Mr. Bell, of Bristol, was using a greater number of metres.

The defects that had come under his observation in the working of the metres had not been serious, and were defects in construction, not in principle ; in the earlier metres, some of the drums and the retarding vanes had been broken, the spindles burred, or the gearing of the counting apparatus injured, but there had been very few stoppages of the latter made metre from any cause.

The Chairman inquired for how long a period he had been making trials of the different metres that had been introduced, and how long he had had Siemens' metre in regular use.

Mr. Greaves said that the East London Water-Works Company had been occupied for 15 years in experiments on metres, in which about £1000 had been expended. His predecessor, Mr. Wicksteed, had taken great pains to arrive at a satisfactory metre, but without success, and had himself made a machine for the purpose, having a double set of double-beat valves, forming in fact a water pressure engine. Other metres also were made, fitted with slides, but it was found difficult to adjust the working of the tumblers to the varying pressure, and the apparatus proved noisy and inconvenient. It was essential to a metre that was to be generally adopted, that it should not be troublesome to the consumers, or they would not use it. He had now had the metre of Mr. Siemens, in its improved form, in regular use about twelve months, and it appeared to fulfil all the requirements of a good and durable metre. It was important, that in case of any injury or stoppage of the metre, the consumer should not suffer thereby, and in this respect there was an objection to all piston metres, for though they might register equally accurately with others whilst in working order, yet if ever they happened to break down, the flow of water was stopped. In Mr. Siemens' metre, on the other hand, if a break down occurred, the flow of the water was not interrupted, and the loss was entirely on the side of the company. In the case of some manufactories, such as sugar works, much damage had been known to accrue from an accidental stoppage in the supply of water, and it was desirable to avoid the serious consequences of such an accident, even at the expense of some loss of water charge, from the metre standing still a day or two; the principle in every instance being that the metre ought to break down against the company, and not against the consumer.

Mr. Bell, of the Bristol Water-Works, said he had used a large number of the metres described in the paper, and had been well satisfied with them: he had brought one of them for the purpose of showing at the meeting the actual results of working. The metre was now, for the first time, taken to pieces since first putting to work, having been in constant work for two years, and it was found in complete order, with very slight signs of wear in any parts, after having measured many thousand gallons of water. It had been used first at a sugar-house, and when tested, on being removed from the house, gave about 2½ per cent. against the company: it was replaced by another metre in about five minutes, and was then taken to the Clifton Baths, and after being used there for some time longer, was again tested, when it was found to be less than 3 per cent. in error against the company, registering 972 gallons instead of 1000. The metres that he used were all tested by means of a 1000 gallon tank, the contents of which were run out through the metre, and the indication noted. It was necessary, in Bristol, to be very careful in the use of metres, as the water had previously been much wasted, and a sea of water would be needed to supply all the waste that would otherwise take place—no springs being sufficient.

He had tried the improved metres of Mr. Siemens under pressures, varying from 25 to 50 and 60 lbs. per square inch, and had found them equally correct under all: he had now 326 of them at work, some having been down two years, and used 1 inch metres to supply 2000 gallons per hour, and ½ inch metres for 400 gallons per hour. He had tested several other rotary as well as piston metres, but none of them were quite satisfactory, as some water was allowed to pass through without being measured. In the piston metre, the cock, by which the entrance and discharge of the water was regulated, was of large size, and he had found it sometimes happen that the tumbler had not power enough to turn the cock over, causing the metre to stand still, and stopping the flow of water.

Mr. Forsyth inquired whether the rolling packing ring, used in Kennedy's piston metre, had been found to be durable: it appeared an ingenious way of getting over the difficulty of packing in a piston metre with little friction, and he had understood it had proved successful.

Mr. Bell replied that he had not had sufficiently long experience of the rolling packing ring to ascertain its durability, having found the metre was not satisfactory in accuracy of measurement.

Mr. Crimes remarked, as the maker of the metre, that the specimen exhibited by Mr. Bell, had been made on the old pattern, at an earlier period of the manufacture, and many improvements in detail of construction had been introduced since that time: the drum was now made of stamped corrugated metal, and considerably lighter, and being well balanced all round, it was probable that the spindle barely touched the sides of the socket at a high velocity of rotation; coming in contact with the socket only at a slower speed. The bearings of the spindle were now increased to nearly three times the original length, in order to prevent the slight wear that was perceptible in the old specimen that had been exhibited. He might mention an unusual experiment that he had recently made, which showed the applicability of the metre to the smallest pressures: in this case, the Lancashire and Yorkshire Railway Company required a metre to measure water out of a canal into a reservoir, which when full was level with the canal, and there was found to be a variation of measurement of only 2 per cent., when the difference of level was reduced to only 3 inches; showing the correctness of measurement under a head of water of only 3 inches, as well as under one of 150 feet.

Mr. Bell said he had tried a somewhat similar experiment with a 2-inch metre, causing 1000 gallons of water to pass through it, first in 16 minutes, then the same quantity in 2½ hours, and lastly the same quantity in 16 hours, and under these great variations in the velocity of the water, the metre registered only 13 gallons less than the correct amount, 3000, being an error of less than ½ per cent., and in favor of the consumer.

The Chairman inquired what oil was used to lubricate the spindle of the drum, a material being required that would continue uniformly liquid, and he thought common oil would not answer in this respect.

Mr. Siemens said that common oil was not suitable, but any oil might be used that was not acid, so as not to act upon the brass-work; pure olive oil and neat's foot oil answered well, or the oil extracted from peat. As a further precaution against corrosion the brass-work was tinned, and the success of the result was shown in the metre exhibited by Mr. Bell, which he had not seen before, and in which there was scarcely any wear after two years' work. This result might appear remarkable considering the high velocity of the drum, but he thought that the higher the velocity, the less wear there would be upon the bearings, because the drum would spin round in the manner of a top or gyroscope, and require in that state no lateral support whatever.

Mr. Crimes remarked that the oil was not required to lubricate the spindle, but was necessary merely to prevent the water entering that part of the metre, and producing a calcareous deposit on the bearing of the spindle: this purpose was indeed now effected with equal success by employing distilled water, but he preferred to continue using oil.

The Chairman thought the practical information that had been given in relation to the subject was very valuable; and the metre described in the paper, reflected great credit on the skill and perseverance of Mr. Siemens.

Boiler Explosions, and the Raising and Use of Steam.[*]

From the Report of the Committee of Management presented to the Second Annual Meeting of "the Association for the Prevention of Steam Boiler Explosions, and for Effecting Economy in the Raising and Use of Steam," held at the Town Hall, Manchester, on Tuesday, the 20th day of January, 1857, we learn that the number of firms registered as members on the 31st of December, 1856, is 462, with 1301 boilers in use at their works, which shows an increase in the number of members reported at the last annual meeting of 193, with 458 boilers. The committee trust that this may be regarded as an evidence that the extra security against accidents afforded by the periodical visits of the inspectors, and the amount of practical information acquired by them, and placed at the service of the members, is now being justly appreciated. During the past year 2246 visits have been made, and 1456 boilers examined by the chief and sub-inspectors. These visits disclosed that 143 boilers, or nearly 10 per cent. of the whole, were in a dangerous condition. No explosions have yet occurred upon the works of any of the members since the inspection began, although in Great Britain generally, not less than thirty-one boilers have exploded during the last year, causing the loss of fifty-eight lives, and serious injuries to upwards of seventy persons.

From the coroners' inquests, as to the causes of boiler explosions within the last year, it is inferred, in the absence of all reference by the witnesses (in so far as has been observed), to surcharged steam as the source of mischief, that this probable cause of accident is little known or suspected. "The fact that steam while in contact with water may be surcharged with heat to a very high degree, without any greater effect on the pressure gauge, or safety valve, than is due to ordinary gaseous expansion, rests," says the Report, "upon the undoubted authority of scientific inquirers. Thus, there *may* accumulate within the boilers a latent force in the form of superabundant heat, which, on the disturbance of the water from any cause, *may* combine suddenly with it, producing steam of excessive pressure, resulting in an explosion." As this conclusion is not universally admitted, even by those who are acquainted with the scientific fact on which *the inference* rests, and is not even known or suspected by most practical men employed about steam boilers, it appears to be a case which calls for a practical solution from the Association, and means will probably be taken within the next year, at the expense of the entrance fee fund, to determine experimentally this important point.

The following remarks are condensed from the Report (dated January

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[*] From the Lond. Mech. Mag., January, 1857.

12th, 1857), made by the chief inspector, Mr. R. B. Longridge, of Manchester, to the Committee of Management:

Causes of Boiler Explosions. 1. *Over pressure.*—Boilers working at a dangerous pressure were principally old Butterley boilers, or cylindrical boilers of large diameter, with few or no stays, and not originally intended for so high a pressure. Several have been replaced, and others strengthened by additional stays, or the pressure has been reduced.

2. *Corrosion and failure of plates.*—The corrosion frequently observed in the interior of boilers is caused by the presence of acids in the water. The remedy is the regular use of lime, potash, or other alkali, to neutralize the acid. Where dampness exists in the seating of a boiler, oxidation of the iron ensues, and the plates are rapidly wasted away. Should this arise from any extraneous cause, the remedy is obvious; but where, as often happens, the dampness is produced by leakage from the seams or fractured plates, this is usually attributed to defective materials or workmanship. Although this often does contribute to such failure, it is not the primary cause. In the majority of cases, leakage and fracture of the plates at the underside of a boiler originate from imperfect circulation of the water. In multitubular boilers, where the greatest heat exists in the upper rows of tubes, the water at the bottom remains comparatively cool and undisturbed, and these boilers are especially liable to leakage. In flued boilers, with furnaces in the flues, one of the seams on the underside, about the middle of the boiler, is often found fractured between the rivet holes throughout a considerable portion of the semi-circumference. In cylindrical boilers, with external furnaces, the steam, rising from the bottom, prevents a regular descending current of water, and any mud or sediment settling on the plates and lying undisturbed, allows them to become overheated, fractured, or even burnt away. Several examples of this kind might be adduced. To remedy these evils, fix in the boiler sheets of iron to separate the ascending and descending currents, or where this cannot be arranged for want of space, convey a large pipe, communicating with the upper part of the water, underneath or within the boiler, with several branch pipes to supply water for the ascending current. The advantage derived would not be confined to the durability of the boiler, but would also contribute to an increased evaporation of water. No point connected with the construction of boilers more deserves the attention of engineers.

3. *Safety valves.*—Although not unfrequently safety valves are found inoperative, from negligence or recklessness on the part of the attendant, this is not a common cause of explosion. The danger of explosion, from the ignorance of the attendants, is considerably diminished by the almost universal use of pressure gauges; but, although these are valuable for indicating the rising or falling of the steam, they should never be considered as substitutes for safety valves. It is a very common but dangerous practice to weight safety valves to correspond with pressure gauges. As an additional precaution, every boiler, or set of boilers, should be provided with an indicator tap to test the gauges.

4. *Water gauges.*—The glass tube is the most perfect gauge for showing the height of the water, and much preferable to the float, on account

of the difficulty of keeping the float-wire sufficiently free to act, without escape of steam at the packing. Where the glass gauges were found inoperative, the passages had been choked with sediment, to which they are very liable where the water is dirty, unless frequently blown through. Such obstructions only show want of attention on the part of the fireman.

5. *Injury resulting from deficiency of water.*—This is a very frequent and most serious source of danger. When flues become overheated from deficiency of water, the temperature of the steam increases in a much higher ratio than the pressure, and the pressure gauge is no longer a true indicator of danger. Many examples prove that whenever heat is communicated to a boiler above the water level, the steam must be surcharged in a greater or less degree, without a corresponding increase of pressure. The water being allowed to fall too low, or the external flues being carried too high, produces the same effect. To provide against this danger, every boiler should be provided with efficient fusible plugs, or safety valves, connected with floats, either of which should be arranged to come into operation and allow the escape of steam, before the water could reach a dangerous level. Where, however, a boiler is already in danger from this cause, the best course to be pursued is to draw or damp the fire, and then leave the boiler to cool, carefully avoiding any measures which might cause agitation of the water, such as starting the engine or opening any of the valves.

On the construction of boilers.—In the Manchester district, boilers of the Cornish or flued construction, from their adaptation to a higher pressure than Wagon and Butterley boilers, have to a great extent superseded these, and though inferior in strength to plain cylindrical boilers, generally receive the preference, on account of superior economy in generating steam. The weakest point in these boilers are the flues, which, in case of deficiency of water, are very liable to collapse. It has not been satisfactorily ascertained what pressure such flues are capable of sustaining, but by some late experiments it has been proved that the strength of cylindrical vessels subjected to external pressure is in the inverse proportion to their length, a fact which seems hitherto to have been unknown, or at any rate disregarded. It seems, on this account, advisable in high pressure boilers of this construction to strengthen the internal flues, if of considerable length, by external rings of T, or angle iron, or, which would be preferable, to join the plates with flanched seams, commonly known by the name of "Adamson's patent seams." As the experiments referred to were only conducted on a small scale, it is highly desirable that further experiments should be undertaken.

The cylindrical boilers without internal flues, though well adapted to high pressure, do not contrast favorably with flued boilers, in economy of fuel. The Galloway or multiflued boilers are much approved of by many, but multitubular boilers will be found the most economical, though hitherto the necessity of frequent repairs has brought them into much disrepute. The difficulty of removing incrustation from the tubes may in most if not in all cases be overcome, by the use of sediment collectors, chemical ingredients, or frequent blowing off.

In regard to the evaporating power of boilers, our present knowledge is very imperfect. The true test of the merits of a boiler, is the weight of water evaporated per pound of coal under a given pressure and in a given time, which can only be ascertained by means of an accurate water metre. Some experiments made in one of Hill's multiflued boilers, with Kennedy's water metre, give an average evaporation of 7·5 lbs. of water per lb. of ordinary Lancashire coal, under a pressure of 45 lbs. per square inch, the rate of combustion being 12·9 lbs. of coal per square foot of grate per hour, and the temperature of the feed water 82°. In the course of the present year further experiments will, it is hoped, be made.

Smoke prevention.—This subject has received considerable attention, and although the progress made in this direction is very limited, it is gratifying to find that a more perfect knowledge of the subject has had the effect of removing much of the prejudice which hitherto existed. Several examples might be adduced to prove both the possibility and advantage of smoke prevention in regard to economy, "but the whole subject," says Mr. Longridge, "has been so thoroughly investigated and explained by Mr. Charles Wye Williams, in his Essay and Treatise on Combustion, that it is quite unnecessary for me here to enter upon it, excepting to add my testimony to the truth of the principles therein expounded."

It may be useful, however, to warn those who feel disposed to act upon Mr. Williams' suggestions, against an error into which many have fallen, in concluding that what succeeds in one boiler must necessarily succeed in all others of the same dimensions, and with the same arrangement of the flues. This does not necessarily follow, for unless in each case there be sufficient draft to bring the due proportion of atmospheric air into contact with the carbon and the gases, the combustion will be imperfect, and since, in some boilers, twice or three times as much fuel is burnt in a given time upon the same area of fire-grate as in others, it is obvious that, in the former, twice or three times as much atmospheric air will also be required. It is from inattention to these different conditions that instances of failure are heard of. The principle is unquestionably correct, and only requires to be thoroughly understood to be applied with success.

Cause of boiler explosions.—The majority of these explosions resulted from inattention to the supply of water.

Steam Engines. *High-pressure steam.*—The economy of high-pressure steam is now generally admitted, but there appears to me to be much misapprehension as to the source of this economy. By many it is imagined that it is derived principally from its generation in the boiler. This opinion seems to have been formed from the observed fact, that the pressure increases in a rapidly accelerating progression—in other words, the higher the pressure, the more rapid the increase. But it has been satisfactorily proved, that the quantity of fuel required to evaporate a given quantity of water increases with the pressure; that is to say, it requires more fuel to evaporate a given weight of water under 60 lbs. than under 10 lbs. pressure, from which we may conclude that no economy will result from the generation of steam at an increased pressure, unless accompanied by a proper use of it in the engine.

Of non-condensing engines it is only observed that in order to work with the greatest economy, it is necessary so to arrange the valves that the steam will be reduced by expansion nearly to atmospheric pressure before escaping from the cylinder.

In *Condensing engines* the steam should be cut off at such a portion of the stroke, that at its termination the pressure of the steam will be reduced by expansion to 8 lbs. or 10 lbs. below that of the atmosphere, previous to passing into the condenser. Otherwise the steam has not done its full work. If, therefore, it be required to expand the steam to this low pressure—say 7 lbs. total pressure—and the valve be arranged to cut off at one-fifth of the stroke, the initial pressure should be 35 lbs. or 20 lbs. above that of the atmosphere, and if 10 lbs. additional be allowed in the boiler, which is more than absolutely necessary, we have 30 lbs. per square inch, beyond which there is no advantage in raising the steam for this class of engine, cutting off at one-fifth of the stroke. We find, however, examples where the boiler pressure is nearly double this amount, while the initial pressure in the cylinder does not exceed 12 lbs. or 14 lbs. per square inch. This arises partly from the mistaken ideas above mentioned, and partly from errors in the arrangement of the valves.

In order to work more expansively and economize fuel, it is usual, where slide-valves are employed, to increase the lap or cover of the valve that it may close earlier; but when this is done it is found that the engine will not drive its load unless the boiler pressure be increased; the explanation is, that the additional lap on the valve has so contracted the opening of the port, that the steam can only enter the cylinder at a greatly reduced pressure. By properly proportioning the lap and travel of the valve, the same result might be obtained without any increase of the boiler pressure.

Another error is, the common practice of cutting out a small piece on the steam side of the valve, in the shape of a V, to admit the steam more gradually to the cylinder, and thus prevent a sudden shock to the engine in passing the centres. To some extent this effect may be produced, but there will at the same time be the disadvantage of wire-drawing the steam, and admitting it to the cylinder when the valve ought to be entirely closed. A better remedy is the following:

So arrange the valve as to close the exhaust port before the termination of the stroke; the steam within the cylinder will then be compressed as the piston continues its course, and will increase in pressure as the space occupied is diminished. By properly proportioning the degree of compression to the initial pressure on the piston, all shock in passing the centres will be obviated, and steam economized. Wherever this has been adopted, it has given the most satisfactory results, and its adoption must eventually become general.

Compound Engines.—These remarks on the arrangement of the valves apply equally to engines working compound. This system, of late brought much into use, is found in some instances to give very satisfactory results, and where additional power is required, is frequently the most convenient mode of obtaining it; but in comparing the best engines of each system, there does not appear that decided superiority in economy in compound engines which might have been anticipated from the greater pressure of steam. The indicator diagrams show that in all engines working compound, there is a loss of pressure, as the steam passes from the high to the low-pressure cylinder, the amount varying according to the arrangement of the valves and the capacity of the passages of communication. What is chiefly required to improve the condensing engine, and make it equal in economy to the compound engine, is a simple variable expansion motion capable of regulating the supply of steam according to the load, without any reduction in the initial pressure, an evil to which most engines are now subjected by the action of the throttle valve. The present valve motions which have this for their object, appear to be too complicated to be brought into general use.

Spheroidal State of Water.

The ordinary explanation of the spheroidal of water assumes that the drop of liquid is separated from the heated plate by an atmosphere of its vapor, which prevents the full transmission of the heat. And this view seemed to be confirmed by experiment and by observation. M. Buff (*Annal. der Chemie. und Pharm.*, *t.* lxxvii. p. 1), rejects this theory, however, on the ground that when the mass of water is great, an electrical current will pass, and he attributes the phenomena to a change of the capillary forces, the liquid ceasing to moisten the solid. The explanation does not appear to us satisfactory. In the first place, the saturated vapor may pass a portion of an electrical current, and the mere change in the ratio of the forces does not account for the very slow evaporation of the liquid, which is the curious part of the phenomenon.

For the Journal of the Franklin Institute.

Description of Coal-burning Freight Engines, used on the Mine-Hill and Schuylkill Haven Railroad, as Improved by R. A. Wilder, Engineer in Chief of said Road. [Built by M. W. Baldwin & Co.]

A represents an apparatus for cleaning coal fires by the power of the engine while running upon the road. It is placed under the grate bars, with the ends of the teeth or fingers always between them, but so far below the fire as not to be affected by it. When the cinder and ashes have accumulated upon the grates, sufficiently to obstruct the draft, the fireman draws the lever A back to the notch, by which means the fingers of the "raker" are raised between the grates into the fire, and at the same time the apparatus is thrown into motion by connecting it with an eccentric, placed on one of the driving axles of the engine. When the grates are cleaned, (which is but a momentary operation,) the lever is released, and the "raker" drops back to its former position.

This improvement enables the fireman, without any physical labor, to keep the grates free from cinder and ashes, and avoid the necessity of stopping to rebuild his fires; thus removing the great obstacle at the present time, to the successful use of anthracite coal in engines of ordinary construction.

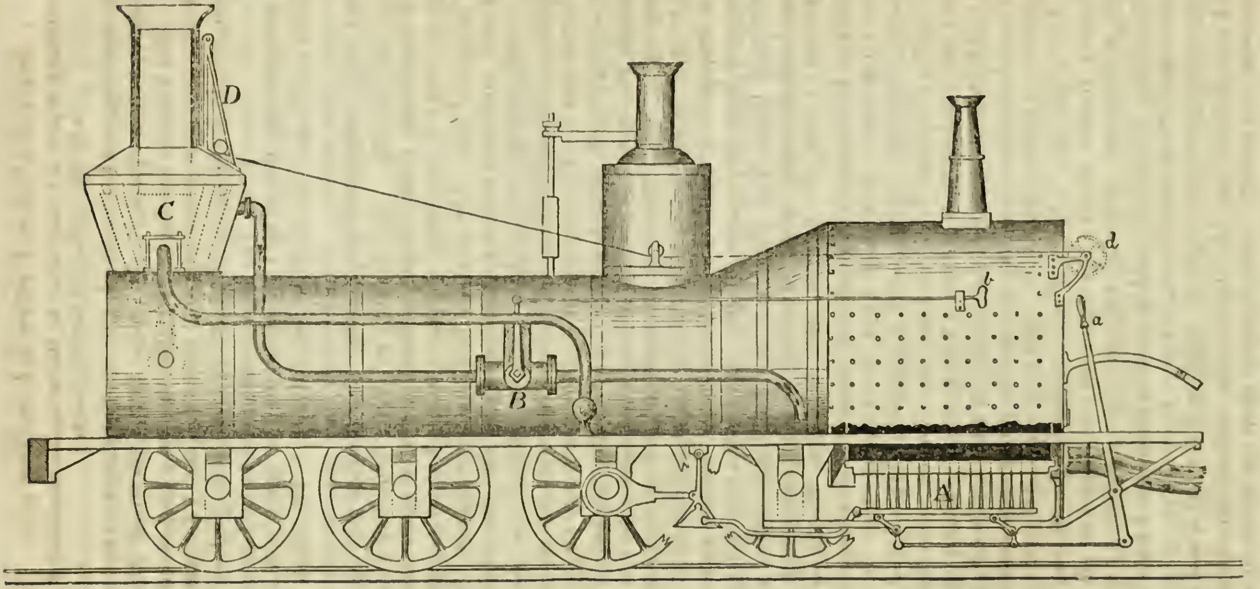
B is a simple arrangement for regulating the supply of feed water to the boiler, by means of a two-way valve and overflow pipe. The pump is always working when the engine is in motion; the indicated position of the arm which moves the valve, shows the water to be passing to the boiler. By drawing back the rod *b*, the overflow pipe is opened, and as the pressure of the steam in the boiler keeps down the check, the water must pass back to the tank. By placing the valve at any point between the two positions described, any portion of the water can be fed to the boiler, and the surplus be discharged through the overflow pipe to the tank.

By this arrangement the supply of water to the boiler can be kept nearly uniform; and in cold weather the freezing of the pump will be prevented.

C is a feed-water heater and spark arrester for the locomotive: it consists of an outside casing, which forms the base of the smoke pipe—a water vessel containing from fifteen to twenty gallons, and a netting of coarse wire, all placed concentric with each other, but far enough apart to insure plenty of draft. The parallel dotted lines represent the water vessel, with the straight portion extending down into the smoke box; the inside dotted lines show the spark arrester, attached to an arched plate, which is placed above the water vessel, and connects the external with the internal flues. The narrow part of the spark arrester is placed over the exhaust pipes in such a way, as to arrest the sparks, but admit the free passage of the exhaust steam through the open stack to the external atmosphere. This improvement is simple and durable, requiring few repairs except to renew the wire netting about once a year.

D is an arrangement for increasing and diminishing at pleasure the effect of the blast from the exhaust steam. It consists of a short straight pipe, permanently fastened to the top of the heating chamber, and another of equal length, which slides over it. A light iron stand as high as it is desirable to raise the outside pipe is placed on one side, with grooved pulleys at the top and bottom; a small wire cord is made fast to the bottom of the outside pipe, and passed over the upper pulley and under the lower one, and thence back to a small winch placed on the end of the boiler, convenient to the fireman. On the side of the pipe opposite the cord attachment, is a friction roller, to prevent the pipe from jamming while being raised and lowered. When the blast needs increasing, the fireman raises the stack by turning the winch, and fastens it by a pawl to prevent it from sliding down again, till the coal is thoroughly ignited. When sufficient steam is raised and the fire burns clearly, the winch is loosened, and the stack lowered by its weight to its former position. It will be seen that the stack may be secured at any point, between the lowest and highest elevation, so as to secure a regular draft adapted to the requirements of the engine.

This arrangement possesses some advantages over the usual method of increasing and diminishing the orifice of the exhaust pipe to regulate the blast, because the power of the cylinder is not affected by it; nor does it influence the vertical passage of the exhaust steam; it is not liable to get out of order, and can be readily repaired or renewed.


D
C
d
b
a
B
A

Experiments with Bessemer's Iron Process.[*]

[From the Official Report of a paper read by Dr. Stevenson Macadam, F. R. S. E., at the Royal Scottish Society of Arts.]

Several experiments have been recently undertaken on the large scale at the Dundyvan Iron Works and Coats Malleable Iron Works, near Glasgow. The furnace employed at Dundyvan was composed of iron, lined with fire-clay, and it was charged with 13 cwt. 1 qr. and 8 lbs. of No. 2 pig-iron, whilst the air (cold blast) was forced in under a pressure of 15 lbs. on the square inch. The iron commenced to boil immediately, followed by sparks and flame, and the production of much slag or cinder, which caused the furnace to overflow occasionally. The blast was continued for eighty-nine minutes, during which time the scintillations, jets of flame and slag, continued to be evolved. The furnace was tapped, and the iron run into moulds. The quantity of metal found in the moulds was only 3 cwt. 3 qrs. 2 lbs., which, added to that thrown out during the operations, viz: 1 cwt. 3 qrs. 12 lbs., gives 5 cwt. 2 qrs. 14 lbs. as the entire weight of pure iron obtained from the experiment. It may be mentioned that, after half an hour, the pressure of air gradually decreased to 5 lbs., owing to the enlargement of the mouths of the tuyeres, but the latter pressure was still found sufficient to penetrate the molten mass. The time employed in this experiment was unnecessarily long, and undoubtedly was the cause of so much of the iron being burned away. The loss was nearly two-thirds of the original amount, being, in round numbers, 8 parts out of 13. The iron obtained was very crystalline and brittle, and, when attempted to be rolled, at once proved itself to be *hot short*. An attempt was made to anneal this iron, by raising it to a red heat, and then very slowly cooling it; as also by keeping the mass at a red heat for sixty hours, and then lowering the temperature very gradually; but both attempts failed in giving other than a highly crystalline and brittle product. At Coats Malleable Iron Works, a circular furnace, built of fire brick, was employed, which was charged with 7 cwt. of No. 1 pig iron. The cold blast, under a pressure of 12 lbs., which decreased to 5 lbs., was forced through the metal for thirty minutes. The usual display of sparks, flame, and slag was observed, and the furnace being tapped, the iron ran into moulds. The product or *bloom* was highly crystalline and brittle when heated and rolled; as also, when reheated and re-rolled, the rods obtained from the first and second rollings still retained this crystalline and brittle character. This iron was *cold short*. Another trial with No. 1 pig iron, subjected to a stream of air for twenty-four minutes, gave a similar result; the successive rollings not yielding an iron of a tough character, or fibrous texture. It is worthy of consideration that the quality of pig iron used in these experiments was "No. 1" at Coats, and "No. 2" at Dundyvan. These varieties are more fusible than the others, contain more carbon, command a higher price in the market, and are generally used by the founder, and not by the puddler. The varieties "Nos. 3 and 4" are generally used in the conversion of pig iron into bar iron. One trial has been made at Coats on No. 4 pig iron, but in fifteen minutes the metal settled down in the furnace; and though it was immediately tapped, yet the iron did not run off, and the furnace was taken to pieces to liberate its iron prisoner.

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[*] From the Lond. Mech. Mag., Jan., 1857.

To a certain extent, the ordinary refinery furnace is the equivalent of the Bessemer furnace, as it is quite possible for all the impurities contained in pig iron to be got rid of in the refinery furnace, with the single exception of the carbon. Moreover, when the pig iron is placed in the Bessemer furnace for a short time, in place of the ordinary refinery, and thereafter introduced into the puddling furnace, a very superior bar iron is the result, as proved by an experiment conducted on a somewhat large scale at Coats Malleable Iron Works.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, May 21, 1857.

John Agnew, Vice President, in the chair.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

A Letter was read from the Polytechnic Institute, of the Kingdom of Bavaria.

Donations to the Library were received from The Commissioners of Patents, and from the Statistical Society of London ; The Polytechnic Institute of Bavaria, Munich ; L. A. H. Latour, Esq., Montreal, Lower Canada ; J. Ross Snowden, Esq., Dr. H. Hartshorn, and Prof. B. H. Rand, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer's statement of the receipts and payments for the month of April was read.

The Board of Managers and Standing Committees reported their minutes.

Three resignations of membership in the Institute were read and accepted.

Candidates for membership in the Institute (3) were proposed, and the candidates proposed at the last meeting (3) were duly elected.

Mr. H. Howson exhibited and explained the following models—Harvester Rake, by Samuel Comfort, Jr., Morrisville, Pa. This invention is applicable to the M'Cormic, Ketchum, and similar class of Harvesters.

The apparatus is free from the rubbing surfaces common to the devices used for a like purpose. It is a most ingenious contrivance, and one containing mechanical movements of an entirely novel character.

Harvester, by Samuel Comfort, Jr., patented March 18th, 1856. The novelty of this Harvester, consists in the employment of an endless chain of cutters, which pass over the top of the cutter bar a sufficient height to allow the grain to fall below the same. A further novelty consists in a series of bent or twisted springs, which act on the blades as they traverse a recess in the cutter bar, in such a manner, as to increase their cutting effect. This Harvester was put into successful operation last season, and found to be remarkably light and easy as regards draft.

Rotary Harvester Rake, by Samuel C. Longshore, Bucks County, Pa. The object of this invention, is to deposit the grain or grass in swathes. This rake is of a very novel character, and if found successful will prove of great value to farmers.

Rotary Cow Catcher, by William Braddock, of Medford, N. J. The rotating cone is substituted for the ordinary permanent grated cow catcher, for the double purpose of throwing the cows, &c. on one side of the track, and preventing the fracture of their limbs which are apt to become entangled in ordinary cow catchers. The operations of this contrivance are assisted by a curved shield in front.

Furnace Grate, by Richard Van Velthoven, of Philadelphia. The object of this invention, is to avoid the necessity of raking out the ashes which collect at the back of the furnace, through the front of the same. It consists of a simple drop or swivel grate, under the command of the attending engineer. By using this contrivance there can be no necessity of disturbing the fuel on the front portion of the grate, and consequently, a great saving of time and labor is effected.

Model for converting Rotary into Reciprocating movement, by Samuel C. Longshore, Bucks County, Pa. This contrivance is intended to impart a reciprocating motion to the cutters of harvesters, saw mills, &c. The principle is not claimed as new, but only the general arrangement.

Mr. Howson also showed a Gas Lighting Lamp, Invented by Abel Wilson, of Frankford, Pa., and some specimens of Ornamental Knitted Fabric, made by a machine invented by Joseph Vickerstaff, of Philadelphia.

Dr. Rand exhibited specimens of sugar from the Imphe or African Sugar-cane ; also a specimen of spirits obtained from the same.

Specimens of Garrett's Composition Metal for lining shaft journals, were presented to the notice of the members.

It is said to possess all the anti-friction qualities of the composition known as Babbett's, with the greater additional advantage of requiring about twice the heat to melt it, which will, no doubt, recommend it to the favorable consideration of those engineers who sometimes melt out a box. It is composed of zinc, copper, and antimony ; the first metal predominating largely. In filling the brasses, which are recessed in the usual way, they are heated, and the metal, which should be just above the melting point, is poured in, and after setting, is hammered to close all the cavities, should any be left after filling. The metal is hard and close, and is said to answer its purpose excellently. Upon the Baltimore and Ohio Railroad it has been in use for several months with satisfactory results; and, Messrs. Merrick & Sons have lined the boxes of the U. S. Steamer *Wabash* with it. A fair comparison of the qualities of Garrett's and Babbett's will thus be made, as the five other steamers last built by the Government, were furnished with Babbett's metal for all the journals.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Mr. Seth E. Winslow's Safety Can and Lamp for Spirit-gas.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Safety Can and Lamp for Spirit-gas, invented by Mr. Seth E. Winslow, of Philadelphia, Penn.,

Report:—That the improvement claimed, consists in the use of a wire gauze diaphragm of conical form extending from the mouth inward like a bag. The gauze for the can is double for greater safety; the gauze in the lamp is single only, and is perforated below, the lampwick passing through the orifice. The can has, moreover, an air-tube passing from the spout near its mouth to the body of the can just under the cork, so that the fluid may be poured steadily without removing the cork. This is not, however, claimed as new.

Diaphragms of wire gauze so well known and so long used for the purpose of preventing the propagation of explosions, have been heretofore employed in burning fluid lamps and cans in one of two forms; either as plane transverse diaphragms stretching across the neck below the stopper, which present a very small surface for the passage of the fluid, and are liable to be clogged by sediment, and to be broken by thrusting the cork too far in, or by other violence; or in lamps, as cylinders extending from the top to the bottom of the lamp, within which the lamp-wick is contained. This latter form allows too much space for the fluid within it, and an explosion may be sufficiently violent to tear the gauze, or, although not extending to the liquid in the body of the lamp, may yet lead to serious damage.

This cannot be the case with the conical diaphragms, which, although simple, yet appear to the Committee to be a new and valuable improvement, adding materially to the safety of these very useful household utensils.

By order of the Committee,

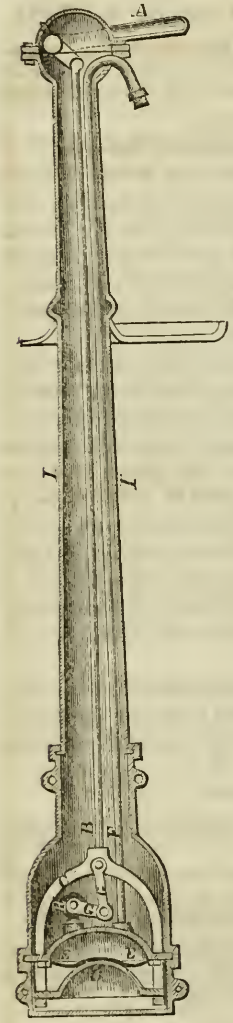
Philadelphia, April 9th, 1857. William Hamilton, *Actuary.*

Report on Mr. James Cochran's non-wasting and non-freezing Hydrant.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, "a non-wasting and non-freezing Hydrant, invented by Mr. James Cochran, of the City of New York,

Report:—That they have examined the above named hydrant, and find it constructed as follows: A hollow cast iron body I, into which the feed pipe H, enters near the bottom, containing an immovable concave iron plate, and to which is attached a disk of gum elastic, E, acting as a movable bottom; under this is a convex piece of cast iron, D, also movable, which is attached by means of an iron yoke C, and cranks to a vertical rod B, and it to a lever handle A, at the top of said cast iron frame.

The supply and exit pipes enter through the immovable concave plate into the box, formed by the plate and gum disk, so that all the water passes through this box.



Upon the supply is constructed a conical tap, so arranged that the water enters at one end in the direction of the taper, and is discharged through a rectangular port in the side, which is $\frac{3}{4}$-inch long and $\frac{1}{4}$-inch wide, so that a very small motion of the tap will open or close it entirely. The water acting in a longitudinal direction of the tap, as the tap wears by use, it is intended to be kept tight by the pressure of the water. This tap is attached by a combination of links and pinions to the yoke and rod before named. The handle is a lever of the second order with fulcrum at end, and the vertical rod is attached by means of a small rock shaft, so that by raising the handle the rod moves in the same direction. By raising the handle, the rod raises the convex plate, and it the gum; and after moving about one inch, the tap is opened and the water commences to flow. By letting go the handle the weight of the rod, yoke, &c., together with the pressure of the column of water, draws it down and closes the hydrant.

The pressure of the cast iron plate being taken from the bottom of the gum disk, the weight of the water from disk to point of exit is intended to press it down, and the capacity of the box being twice as great as the exit pipe, it empties the pipe, and the water returns again into the box.

Upon opening the hydrant by raising the handle, the convex plate is caused to ascend and press against the gum disk, forces the water contained in the box into the exit pipe, and a continuous stream follows. The tap is so arranged that it does not open until the disk has nearly reached its height, so that the water in the box is thrown into the pipe before more is admitted.

It is claimed, that this hydrant can be repaired without digging it up, which if so, is certainly a very desirable object gained. The iron post or hydrant is encased in a wooden box, which will not require repairing oftener than an ordinary hydrant.

When the supply pipe and gum box is placed a sufficient depth below the surface, (say about five feet, which is the depth the ground has sometimes frozen,) as there is no waste above the box, it is impossible to freeze.

In conclusion, the Committee take pleasure in recommending it as an ingenious contrivance, and worthy of trial.

By order of the Committee,

Philadelphia, April 9th, 1857. William Hamilton, *Actuary.*

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